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Published Monthly by Reinhold Publishing Corporation, 330 West 42nd St., New York (18), N. Y., U.S.A. Ralph Reinhold, President and Treasurer; H. Burton Lowe, Vice President and Secretary; Philip H. Hubbard, Vice President; Francis M. Turner, Vice President; William P. Winsor, Vice President; G. E. Cochran, Vice President. Price 25 cents a copy. Annual Subscription: U. S., Possessions and Canada, $2.00. All Other Countries, $3.00. (Remit by New York Draft.) Copyright, 1944, by Reinhold Publishing Corporation. All rights reserved. Entered as second class matter at the Post Office at New York, N. Y., under the Act of March 3, 1879.

METALS and ALLOYS

The Engineering Magazine of the Metal-Working Industries

VOLUME 20 • NUMBER 2 • AUGUST, 1944

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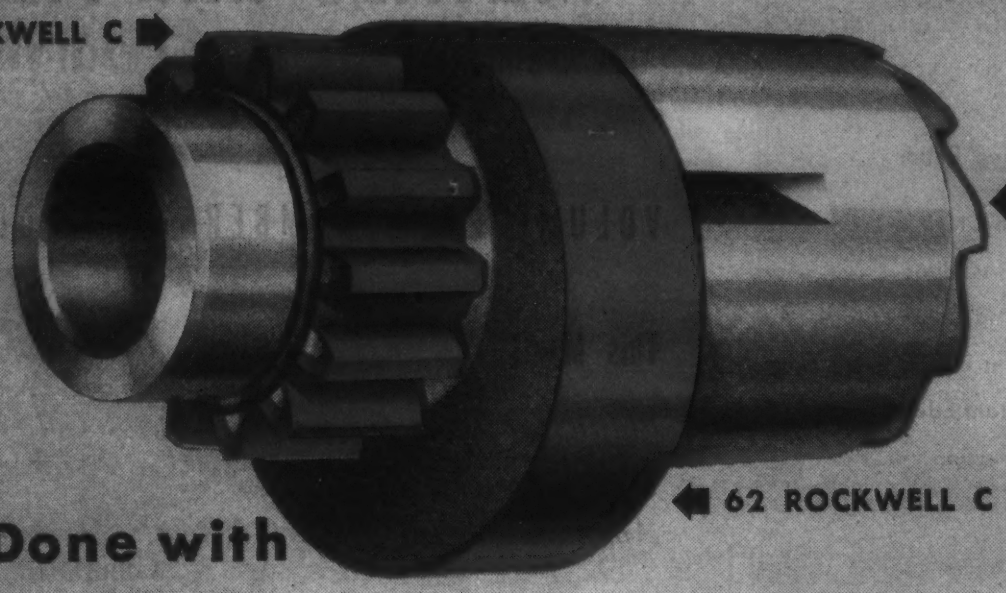
How would you solve this Differential Hardening Operation?



It Can Be Done with

VAN NORMAN HIGH FREQUENCY "Packaged Heating"

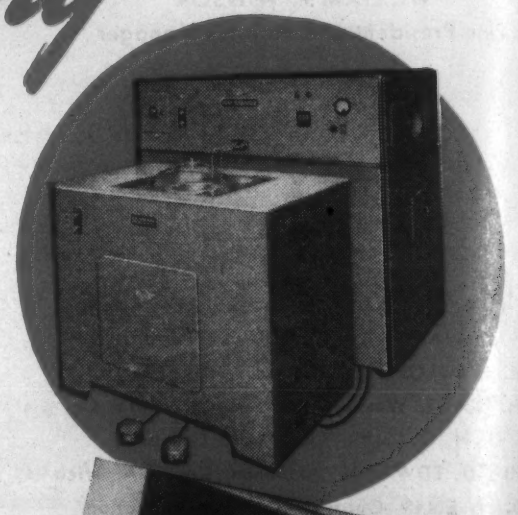
Illustrated, above, is the driving mechanism for operating an oil pump plunger. For specific design reasons, it is necessary to have the gear teeth, eccentric, and clutch teeth, which are cut integral with the shaft . . . *each a different hardness.* Since the gear teeth and eccentric are only 1/4" apart, conventional methods can't be used for this differential hardening job. How would you solve this problem?

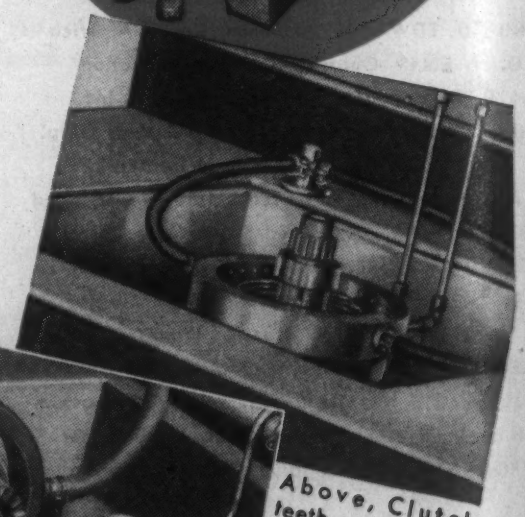
The differential hardening is easily done with Van Norman High Frequency "*Packaged-Heating*" because Van Normanizing makes it possible to control the hardened area to within a fraction of an inch.

Pictured at the right are two of the setups. Clutch teeth are hardened to 57 Rockwell C in 13 seconds; eccentric to 62 Rockwell C in 22 seconds; gear teeth, in a similar setup as clutch teeth, in 16 seconds. There is no warping or distortion and cleaning operations are eliminated as the finished part is free from scale.

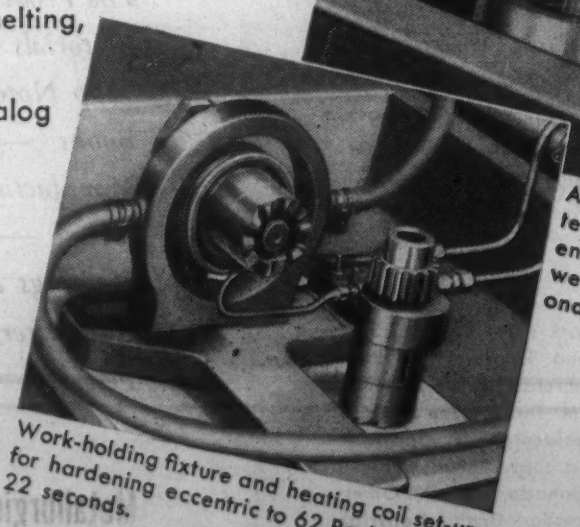
Differential hardening is but one of the many operations accomplished with Van Norman High Frequency "Packaged-Heating." Other operations include brazing, soldering, annealing, forging, melting, etc. Each can be performed faster, better at lower cost.

Investigate Van Norman "Packaged-Heating." Write for catalog today.





Above, Clutch teeth are hardened to 57 Rockwell C in 13 seconds.



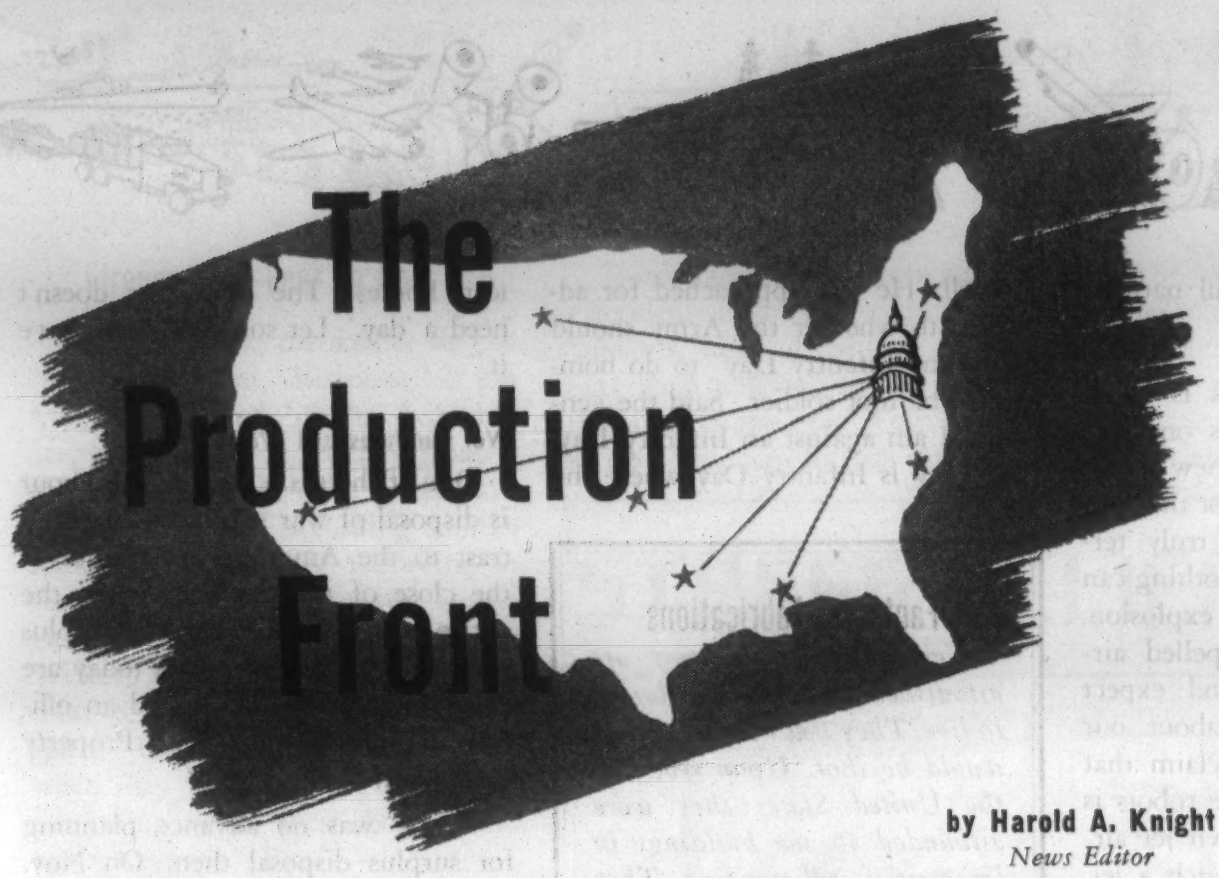
Work-holding fixture and heating coil set-up for hardening eccentric to 62 Rockwell C in 22 seconds.

VAN NORMAN COMPANY

ELECTRONICS DIVISION

SPRINGFIELD 7, MASSACHUSETTS

"It pays to Van Normanize"



The Production Front

by **Harold A. Knight**
News Editor

History will prove Hitler the world's corniest "ham." . . . Didn't reckon with English who never know when they're beaten. . . . Nor with that manufacturing monstrosity that is America. . . . Nor the A B C's of the law of retribution. . . . Nor that slave labor makes for poor world economy. . . . "Strongest army should be in the hands of the most peaceful nation."

Secret weapons know no holiday. . . . Sure death within 100 feet. . . . We have turned out 300 new weapons, with 1000 projects pending. . . . Infantry "Day"—give the day to somebody else. . . . We had no advance planning for disposal of surpluses in 1918. . . . Certain metal statistics are enlightening. . . . "Facts" win over "fabrications."

Our new department, "Stress Relief." . . . "Victory comes to the side that can bring to bear the greatest firepower," says Maj.-Gen. Barnes. . . . C.E.D. considers liquidation of war production, immediately peace comes. . . . Where does conscience restrict our weapons? . . . The "gob" no longer hoists powder—pretty soft!

Major Task: Unscrambling Hitler's Deeds

One of these days—perhaps soon—the European war will be over, though the text of this department will read as though the war was still continuing—all due to the lag between the time the text is written and date of publication.

We know that our leading thought will be then—as it is now—that Adolf Hitler will go down in the history books as the Greatest Fool of All Time. None but a fool would have failed to realize when he made his "pustch" 's—first against one country and then another—that sooner or later the democracies would take steps to block his designs.

Didn't Hitler know the indomitable spirit of the English—a country that never knows when it is beaten? Didn't Hitler remember how in the first war Haig's British army was backed up against the sea—licked, but the British didn't know it and kept fighting?

Didn't Hitler know the resources, technical skill, inventiveness, mass production methods, history of war successes, etc. of the American people? Didn't Hitler know from the first World War that the German submarine can be beaten? Didn't Adolf know that America was the cradle of the airplane? That any effective innovation in German aircraft design would be watched and exceeded by some counterdesign in the United States?

Couldn't Hitler envision the punishment that would be meted out to Germany this time? Didn't Schikelgruber realize that no nation truly wins wars? That the whole world level is dragged down by a major conflict? Resources destroyed? People debilitated? Level of civilization lowered? Hates engendered that last for years?

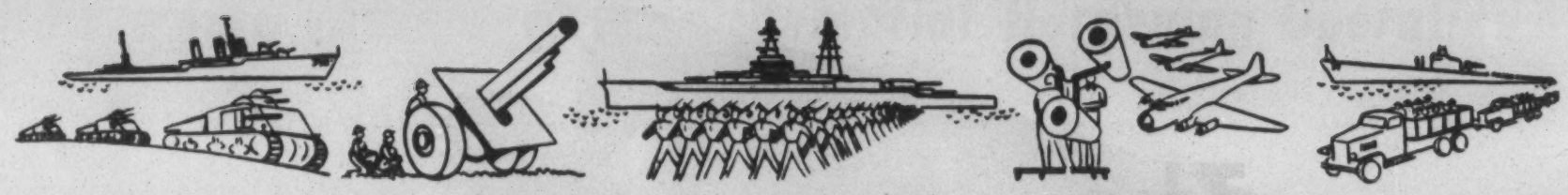
Didn't Hitler know that a slave economy is not the best economy? That slaves have no buying power and that large buying power generally throughout the world makes for most bounteous prosperity?

Didn't Adolf realize that there is a law of retribution in this universe that follows as certainly as night follows day? That the murder of races, non-combatant men, women and children brings down the wrath of the Gods of the Universe?

Greatest Fool of All Time

Perhaps, even as this is being read, Adolf Hitler is no longer among the living. In his 55 years he has won the dubious sobriquet of "Greatest Fool of All Time."

But let us Americans ever remember that there has been a bit of fool in us. The infamy of unpreparedness at Pearl Harbor will ever live. We quote from a remark attributed to one late Prof. C. H. Van Tyne, head of the history department, University of Michigan: "We will never have universal peace until the strongest army and strongest navy are in the



hands of the most peaceful nation."

Parade of Secret Weapons

But, meanwhile, as this is being written, the war still goes on. We have heard vaguely of a new secret weapon of ours used against the Japs on Guam and Tinian—a truly terrible dispenser of death—nothing can live within 100 ft. of its explosion. We hear of new jet propelled aircraft of the Luftwaffe and expect hourly for more details about our own jet airplanes. Some claim that the best way to combat the robots is to chase them with our own jet airplanes—it takes a jet to catch a jet.

We have heard some rumblings of disapproval on the ground that German Mark V's and VI's are superior to American tanks. But we remember what they told us about tanks at Aberdeen. You can't have everything in a tank. Can't have heavy and impregnable armor and good maneuverability. It is true that not all our guns will pierce the front armor of a German tank, but maneuverability allows us to jockey around to hit them on the side.

Interesting is the new bombsight developed by the British, accurate to four miles above sea level and operable whether the bombing plane is flying up, down, turning fast or slow. It is valuable for night operations and low-altitude bombing. Called the T-1, it weighs 55 lb. and contains 4212 pieces. Operating parts actuate by high air pressure and vacuum developed by special pumps connected to the plane's fuel system.

The robot bomb is one of the few German innovations in this war, while U. S. ordnance has already turned out 300 new weapons and has more than 1000 Ordnance development projects under way.

Let's Not Forget the Fighting "Front"

At times, we fear, we have overemphasized the importance of our "Production Front" and not given sufficient credit to our fighting fronts. We are reminded of that sterling, earthy soldier, who recently became a four-star general—"Vinegar Joe" Stilwell. He was approached for advice as to whether the Army should create an "Infantry Day" to do homage to the foot soldier. Said the general: "I am against an Infantry Day. Every day is Infantry Day where the fighting is going on. The doughboy doesn't need a day to be remembered—his example of unselfish effacement of individuality for the common good is before us every day, and he is remembered for it in millions of American homes. The doughboy doesn't need a 'day.' Let somebody else have it."

Facts vs. Fabrications

German war prisoners are astonished that they are allowed to live. They had been told they would be shot. Upon reaching the United States they were astounded to see buildings in large cities still standing. They had been told they were leveled by German bombs.

Churchill exhorted that only "blood, sweat and tears" would save England. Hitler boasted that Germany was to attain rank of supreme nation for at least 1,000 years. At Dunkurque the democracies admitted freely "too little and too late." Hitler kidded his people that they were supermen.

In more recent months Hitler calmed his herrenvolk by stories of big central troop reserves. Yet armored units were shipped from the Russian to the Normandy front and units from Norway and Denmark reinforced in Italy.

Americans admit that one third of our potential draftees are physically unfit for service. The British have told truthfully of the damage done by robot bombs, and Churchill has not promised an antidote.

In short, the present war is demonstrating that the side that talks in terms of facts wins over an enemy that deals mostly in fabrications.

War Surpluses and War I

One of the main topics of the hour is disposal of war surpluses. "In contrast to the American experience at the close of the last war, when the entire war machine became surplus almost overnight, surpluses today are developing gradually," stated an official of the Surplus War Property Administration.

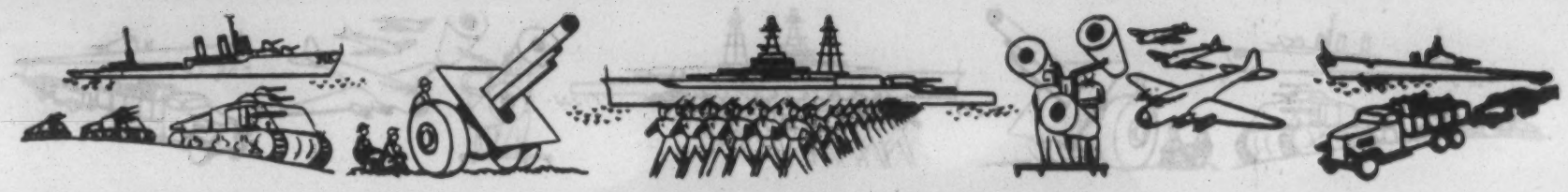
"There was no advance planning for surplus disposal then. On Nov. 11, 1918, industry was almost totally unprepared for contract cancellations, which came almost immediately, though in many cases requested suspensions were delayed for 30 days. Confusion is a mild term for the situation. Contractors stormed the commodity section of the War Industries Board for aid. Business groups placed identical orders with several firms in the hope of getting one delivery of surplus goods. Transportation facilities jammed. Prices soared. Strikes tied up plants. Meanwhile, surpluses massed higher and higher. It was not until six months later that legislation was passed authorizing the President to dispose of surplus material."

Recent Metal Production Figures

Some important statistics have been released recently. Alloy steel output the first half of 1944 was 5,466,323 tons, or 12% of total steel output, compared with 16½% of total the first half of 1943.

Production of aluminum in 1943 was 1,083,479 tons, of which 163,300 tons was secondary. Output of magnesium in 1943 was 183,584 tons, primary, against 3,350 tons in 1939, with 1943 output of secondary, 11,404 tons.

Refined lead from primary refineries in 1943 was 471,475 tons, against 579,695 tons the previous year. Production in 1943 of zinc, primary and redistilled secondary, was 990,524 tons compared with 945,067 tons in 1942.



Firepower—Four to One

That G.I. Jack, the soldier on the "production front," has done his job well, is indicated by the fact that firepower on the Normandy front is 4 to 1 in our favor. The Allies have not been fighting "according to high standards of chivalry," according to Field Marshall Guenther von Kluge, German chief commander on the Western front. "We are not faced by infantry imbued with truly offensive spirit. They go to the attack only when they think they have smashed everything with their bombs and heavy weapons." But—

"Victory comes to the side that can bring to bear the greatest firepower," stated Maj.-Gen. G. M. Barnes, chief of the Army Ordnance Dept.'s Technical Div., during an exclusive interview conducted by METALS AND ALLOYS.

"Speaking of firepower, typical was an incident on the Italian front. During the night the Germans concentrated a large number of troops and armor. They attacked at dawn. Our artillery immediately laid down a barrage of over 5,000 shells in 15 min. and completely broke up the attack before it reached our lines.

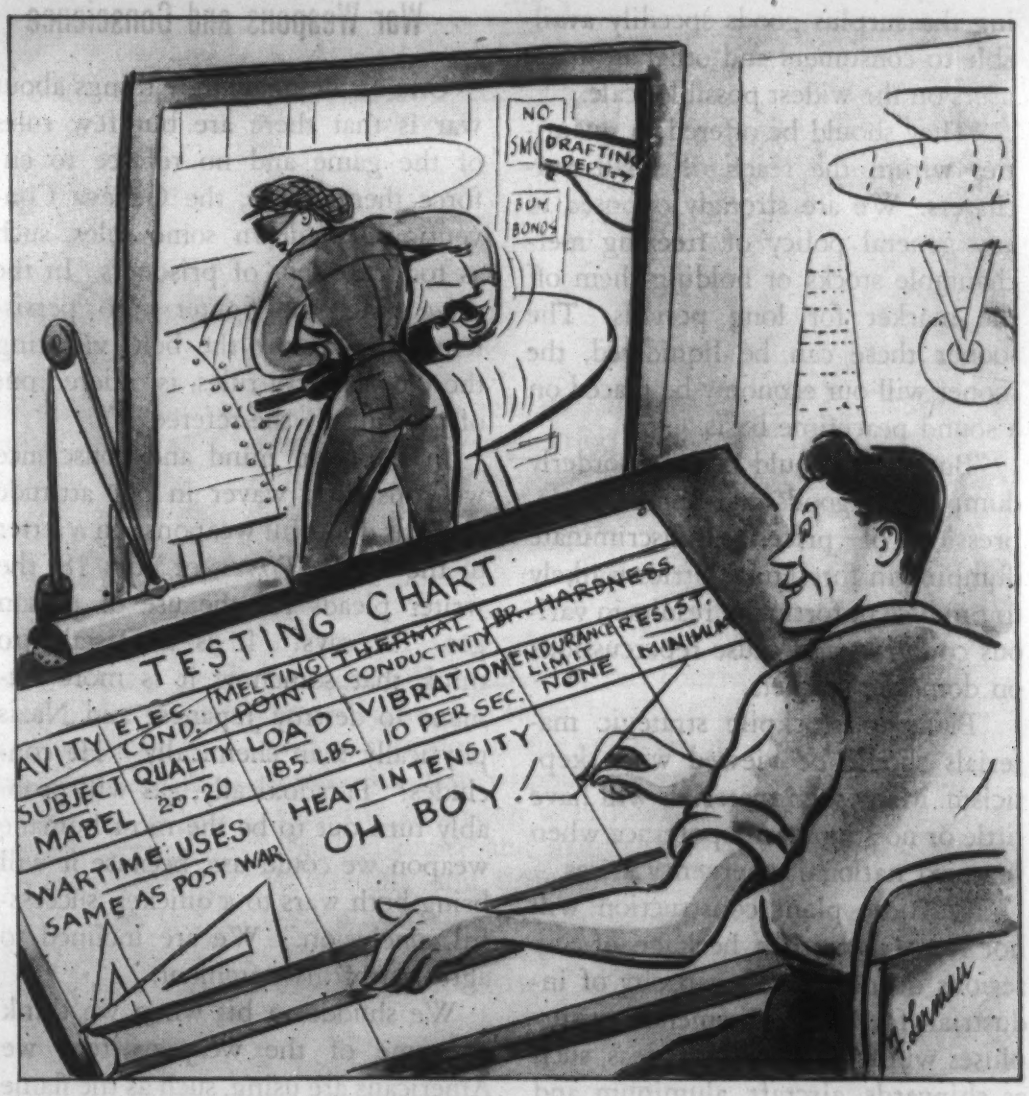
"First reports from Normandy indicate that no new nor startling enemy weapons have been used there in battle," continued Maj.-Gen. Barnes. "From our tests and battle experience our weapons in all cases are at least as good as the German, and in most cases definitely superior.

"Rockets were first used in this war when the American bazooka surprised the German tanks on the battlefield and destroyed them. They are effective against both tanks and pill boxes. They are used extremely effectively on all battlefronts. They are used on aircraft and to supplement artillery fire.

"Our planes with their rocket guns have blasted Jap ships and landing barges, shot up locomotives, munition dumps and bridges. Improvements are being made all the time in rockets, but so far they are not as accurate as artillery.

"Workmanship on enemy material is decidedly inferior, according to our standards. Most of their weapons require hand finishing to get the parts to fit during assembly. Our weapons are mass produced to such close tolerances that the parts are completely interchangeable."

STRESS RELIEF By GILBERT



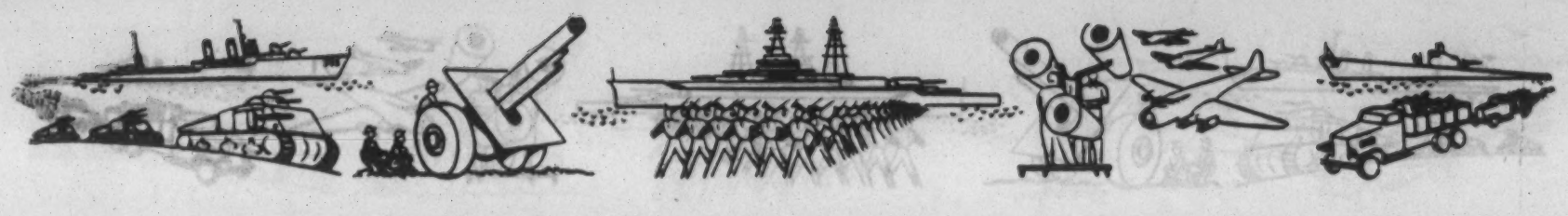
Liquidation of War Production

"A satisfactory level of productive employment after the war will be attained only as a result of a national output of goods and services 40% greater than that of 1940," it is stated in one of the most important studies made to date by the Committee for Economic Development. "If the war should end tomorrow, there would be outstanding between $80 and $100 billions of uncompleted war contracts.

"The general policy should be to cancel war contracts and to terminate war production work immediately when it has become clear that such production does not serve a demonstrable need in connection with the war effort or will not be needed in our post-war economy." (In short, let's not continue just to make work.)

"The reopening of civilian production should be planned to coordinate with contract cancellations so that small manufacturers will not be left stranded without any war orders and still unable to resume the production of peacetime goods.

"Surplus of war materiel, including contractors' inventories, will not exceed $60 billions, three-fourths of which will be in combat ordnance.



Perhaps one-fourth, or $15 billions, will be in merchantable goods, over half of which will be abroad, with $6 or $7 billions here, or less than two months' retail sales.

"Aircraft and shipping account for 50% of the current war supply program. A major part of aircraft may have to be scrapped. In formulating a policy of surplus disposal, the general objective should be one of making the surplus goods speedily available to consumers and other ultimate users on the widest possible scale.

"They should be offered in quantities within the reach of small purchasers. We are strongly opposed to any general policy of freezing merchantable stocks or holding them off the market for long periods. The sooner these can be liquidated, the sooner will our economy be placed on a sound peacetime basis.

"But there should be no disorderly dumping of goods and abnormal depression of prices. Indiscriminate dumping in foreign countries is likely to produce unfortunate results in various countries and cause repercussions on domestic markets.

"Plans to stockpile strategic materials should be viewed with skepticism. Many such materials will have little or no strategic importance when the next national emergency arises.

"Wartime plant construction will not leave us with a heritage of any serious over-all excess capacity of industrial facilities. Tremendous surpluses will exist in certain areas, such as shipyards, aircraft, aluminum and magnesium, while important shortages are likely in other areas.

"Present capacity for producing aluminum and magnesium appears enormous in relation to prewar demand, but it is conceivable that demand will catch up with capacity within a decade. The moderate surplus of iron and steel capacity is not likely to prove onerous.

"In formulating a disposal policy for war plants, a governing objective must be encouragement of private operation under competitive conditions. Government plant disposal cannot be based on full recovery of original cost.

"At the earliest possible date the military agencies should decide what facilities they wish to retain as standby plants for military purposes and which they can turn over for private operation.

"Plants too large for peacetime operations should be divided or dismantled to permit use of their equipment."

War Weapons and Conscience

One of the many ugly things about war is that there are but few rules of the game and no referee to enforce them. True, the Geneva Convention laid down some rules, such as for treatment of prisoners. In the prize ring, the fighter who persistently hits below the belt, violating the Queensberry rules, is ordered out of the ring by the referee.

In our own mind and conscience we constantly waver in our attitude towards doubtful weapons. In a letter to the *N. Y. Times,* of July 18, the writer pleads for the use of poison gas. He says: "It is a mistake to think that somehow it is more humane to destroy Japanese and Nazis physically than chemically." He concludes: "Paradoxically, gas will probably turn out to be the most humane weapon we could use, because it will bring both wars to a quicker, successful conclusion." We are inclined to agree with this statement.

We shudder a bit when we think of some of the weapons that we Americans are using, such as the flame thrower. That would seem to be a far step down into the abyss from the gallantry of Revolutionary War days. Remember how the British soldiers marched into battle in perfect line, their red coats a perfect target, with their white straps crossing in front of the heart? (Perhaps the joker there is that in view of the erratic firing of the American muskets they were pretty safe, at that.)

Then consider our own phosphorus shells of today—thrown by our "goon guns," or 4.2 in mortars. We recall when as a student in Chemistry one of our laboratory mates received a phosphorus burn that never seemed to heal. Upon our impressionable youth that made a profound imprint.

Then the other day we read a pathetic letter taken off a dead German in Normandy to his young wife. He told of the terrific Allied bombardment until few of the Germans were still alive—and many of those still living had phosphorous wounds which never healed.

Our "goon gun" is a devil, if there ever was one. Developed to hurl gas, it has become one of the most versatile of chemical weapons. It not only routs the enemy with a stinging white phosphorous, broadside, but also blinds him with smoke and pelts him with high explosives. Only 3½ ft. high, weighing 300 lb., it fires so rapidly the enemy first mistook it for an automatic cannon.

Yes, our conscience often wavers, yet always winds up by approving our most terrible weapons. Nothing can be too bad for our bestial, vile enemies in this war!

Powder and Projectile Hoists

Powder and projectile hoists on U.S. battleships, cruisers and aircraft carriers are composed of more than 3,000 parts of very close tolerances. Their purpose is to elevate a 5-in. projectile, weighing 50 lb., from the ship's magazine to the guns on deck. They permit a more rapid conversion of dual purpose guns from surface to anti-aircraft fire, and have done much to enable warships to hold their own against massed enemy air attacks.

While projectiles are being raised in one hoist, powder is raised in another hoist on the opposite side of the ship. Each hoist weighs 6,750 lb. and is 12 ft. high. They eliminate tremendous manpower. One of the prominent manufacturers of these hoists is Willys-Overland Motors, Inc., Toledo, Ohio.

One of the feature articles in this issue is entitled, "Ammunition-Hoist Parts Efficiently Machined," an article which we believe is the first to be published on the subject. The war indeed becomes more mechanical each day. The German robot bombs are just another striking instance.

Steel for Victory

The American steel industry is still maintaining this year the remarkable record it made in 1943 in producing steel for victory. For the first six months of 1944, despite increasing shortages of manpower, the industry turned out 45,061,874 net tons of ingots and steel for castings, says the American Iron and Steel Institute—a new record for any half year.

The total was almost 1,200,000 tons in excess of the 43,886,451 tons in the first half of 1943—the record year in total tonnage. It even exceeds by a small margin the previous six months' record of 44,949,915 tons in the last half of 1943.

An interesting fact concerning this achievement is that this increase has been wholly in open-hearth steel. There has been a decrease this year from last in the output of both Bessemer and electric steel. The open-hearth furnace is still the backbone for large production in the industry.

In the record year of 1943, when 88,836,366 tons were made, the production in the last half exceeded that in the first six months. Should this relative proportional rate of output prevail for the last half of this year, a new record in 1944 may be rung up. The present total to July 1 has been 45,061,874 tons so that the 1944 total could easily exceed 90,000,000 tons.

Much will depend on the course of the war and the cutbacks in orders to the mills. Also on how long the strain in the equipment and on the personnel can last without a severe letdown. In any event the American steel industry as a whole merits unstinted praise and many Army and Navy E's. An outstanding and brilliant war record has been and is being made, unequalled in the history of any country. Success in our war effort would have been impossible otherwise.

—E. F. C.

Steel and Public Relations

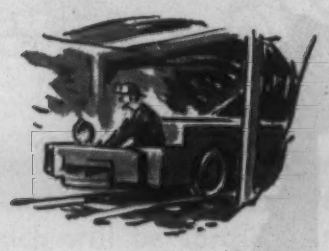
The need for more aggressive public relations work is one of the paramount needs of the steel industry. This was the gist of "extemporaneous" talks of two of the leaders of the industry at the annual meeting of the American Iron and Steel Institute in May. Each of this group of speakers chose his own subject. The fact that two picked the same topic would indicate that this is one of the uppermost problems.

A survey among the general public revealed that the average man believes that steel makers are reaping exorbitant profits, have raised the price of steel fantastically since Pearl Harbor and that the steel industry is one of the most dangerous to work in. So stated Edward L. Ryerson, chairman, Inland Steel Co. He said further that aircraft and shipbuilding rank higher, as essential war industries in the eyes of the public, than steel. "Trouble is, we don't have direct relationships with the public. This means we must push our public relations work," he concluded.

Suppose we try to analyze the reasons for this alleged unpopularity. In the first place aircraft and radio are new industries, starting out without prejudices built up through the years. If Wall Street were as pure as the lily today, it could not live down the fiction that it robs widows and orphans.

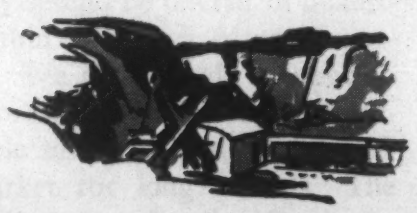
The steel industry finds itself the goat partly be-

A TON OF FINISHED STEEL REQUIRES

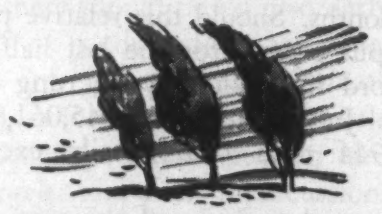


ORE—2,800 LBS.

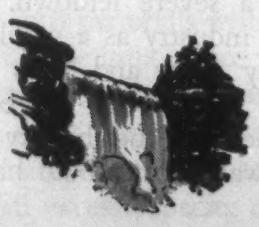
COAL—1,600 LBS.



LIMESTONE—825 LBS.



AIR—16,000 LBS.



WATER—480,000 LBS.

Some job to make a ton of steel

But America Makes Millions of Tons a Year

Have at hand—2,800 pounds of iron ore; 16,000 pounds of air; 480,000 pounds of water; 87,000 cubic feet of gas; 1,600 pounds of coal; 825 pounds of limestone; 4,300 pounds of steam; 1,500 pounds of steel scrap—also fluxes, alloys, refractories, electric power, sulphuric acid, muriatic acid, fuel oil, pitch . . . and furnaces capable of developing 27,000,000 B. t. u. for each ton of steel to be shipped.

Making a ton of steel is complex in method and equipment, as well as in the number, and quality of ingredients, supplies and utilities.

At Inland these complex processes are controlled by a large staff of metallurgists working in laboratories and in the plants, and by specially trained engineers who constantly investigate and design new mechanical methods and equipment. Basic ingredients—ore, limestone, coal and fluorspar—come from Inland owned mines and quarries—selected and blended to meet the needs of critical steelmakers. All other supplies are obtained under rigid specifications.

The Inland "know how" for making each ton of steel is giving America quality steels for Victory—later it will help supply the quality steels for America at peace.

INLAND STEEL COMPANY

38 S. Dearborn St., Chicago 3, Illinois

Cincinnati • Detroit • Kansas City • Milwaukee • New York • St. Louis • St. Paul

cause it has become a symbol like Wall Street. True enough, in the early days steel was a rough and tumble industry, with tough men at the head and tough conditions of work. But there were other tough industries like the railroads with their "public be damned" attitudes. There were oil companies that in the night tore up pipe lines that rival companies had laid down.

Practically all industry has by now put on kid gloves. In the case of the railroads the public can see the change for the better because the public rides on trains. But the average citizen does not get inside the steel mill. The public still remembers from books the bloody Homestead strike; it does not see the thousands of plans and devices today for making the workman safe and comfortable.

Unfortunately, too, the steel trade has suffered from the New Deal's apparent hostility towards big business—and steel is one of the biggest businesses. The public does not see what we who work in close contact with the industry have observed—that steel executives as a class and as individuals are among the fairest and squarest in industry. They are hard working, straight shooting, two fisted and just. Ethics are high and shady practices are frowned upon.

Yes, the public must be told through smart public relations work what many of us already know.

—H. A. K.

Which Material for Tomorrow's Freight Cars?

There is strong evidence that certain progressive railroads are looking to the post-war era with special emphasis on the kind of material they can most economically and efficiently incorporate in their new equipment. A striking example of this is the recent order from the Missouri Pacific Railroad for 25 aluminum alloy 70-ton hopper freight cars to be made by the American Car & Foundry Co.—said to be the first railroad ever to place such an order.

Some of the objects of this experiment are to determine the life of the car, its durability and efficiency, its corrosion resistance, the increase in pay-load and so on. By using a material lighter than ordinary carbon steel, section for section, the net weight of the car is reduced with a consequent increase in pay-load.

In the case of these aluminum alloy cars, the entire body is aluminum with the center sill and bolster of steel. The cars empty will weigh about 38,000 lb. each as contrasted with an average weight of 50,100 lb. for the conventional steel 70-ton hopper cars, or about 12,100 lb. less for the locomotive to pull. These cars will also be 39 in. longer than the usual steel units with a consequent increase in capacity of 240 cu. ft. The aluminum sheets and plates are to be somewhat thicker than the conventional steel to give them equal strength. The net result is manifestly a substantial increase in pay-load.

Another material which may enter this picture is the group of low-alloy, high strength steels of which there are a number—Corten, Yoloy, Republic Double Strength and so on. These steels, because of their high tensile strength and elastic ratio, can be substituted in thinner gages than the conventional carbon steel plates or sheets, resulting in a lighter car and an increase in pay-load. Many of them have superior anti-corrosion properties.

The results of the Missouri Pacific trial will be awaited with keen interest, and much will depend on the outcome. The railroads are down to rock bottom in their supplies of both freight and passenger cars. There will hence be a scramble for material for new cars. The more light that can be thrown on the relative merits of the ordinary steels, the low-alloy high strength steels, and the light metal alloys, the better for the railroads and all concerned. There will be plenty of aluminum and magnesium. The low-alloy steel types have been necessarily neglected during the war—characterized by one authority as the "forgotten steels"—but the supply can be ample.

The problem deserves careful and thorough study; when it is broadened to include not only freight cars but passenger cars as well, cold-rolled stainless steel must also receive strong consideration, and other materials (for example magnesium alloys) present themselves for use in specialties and non-structural equipment. In any case the question of the relative price of the materials will have a decided bearing on the results. —E. F. C.

The Gingham Dog and the Calico Cat

The situation of some of our once highly critical materials, now available in what might be called abundant supply, reminds one industrialist we know of the gingham dog and the calico cat who were bent on ruining each other.

In the case of his material (beryllium) the supply was at first much too limited for the demand and WPB discouraged the use of beryllium-copper so that the expanding plants of the industry might have time to finish their building and start catching up with demand. But just about the time the plants were completed it was discovered that the discouragement effort had been too successful, and the beryllium industry is now seeking uneasily to revive interest in that metal.

Steps are now underway to discontinue the allocation of beryllium products (except beryllium-aluminum and beryllium-copper, where it is still necessary to control the aluminum and copper). With the recent authorization for the use of aluminum in the manufacture of certain civilian products, the worrisome stockpiles and approaching oversupply of other non-ferrous metals, and a growing sales aggressiveness on the part of manufacturers of once-tight materials like stainless steel it looks as though something resembling the normal push-and-pull of supply and demand may soon be felt in some directions.

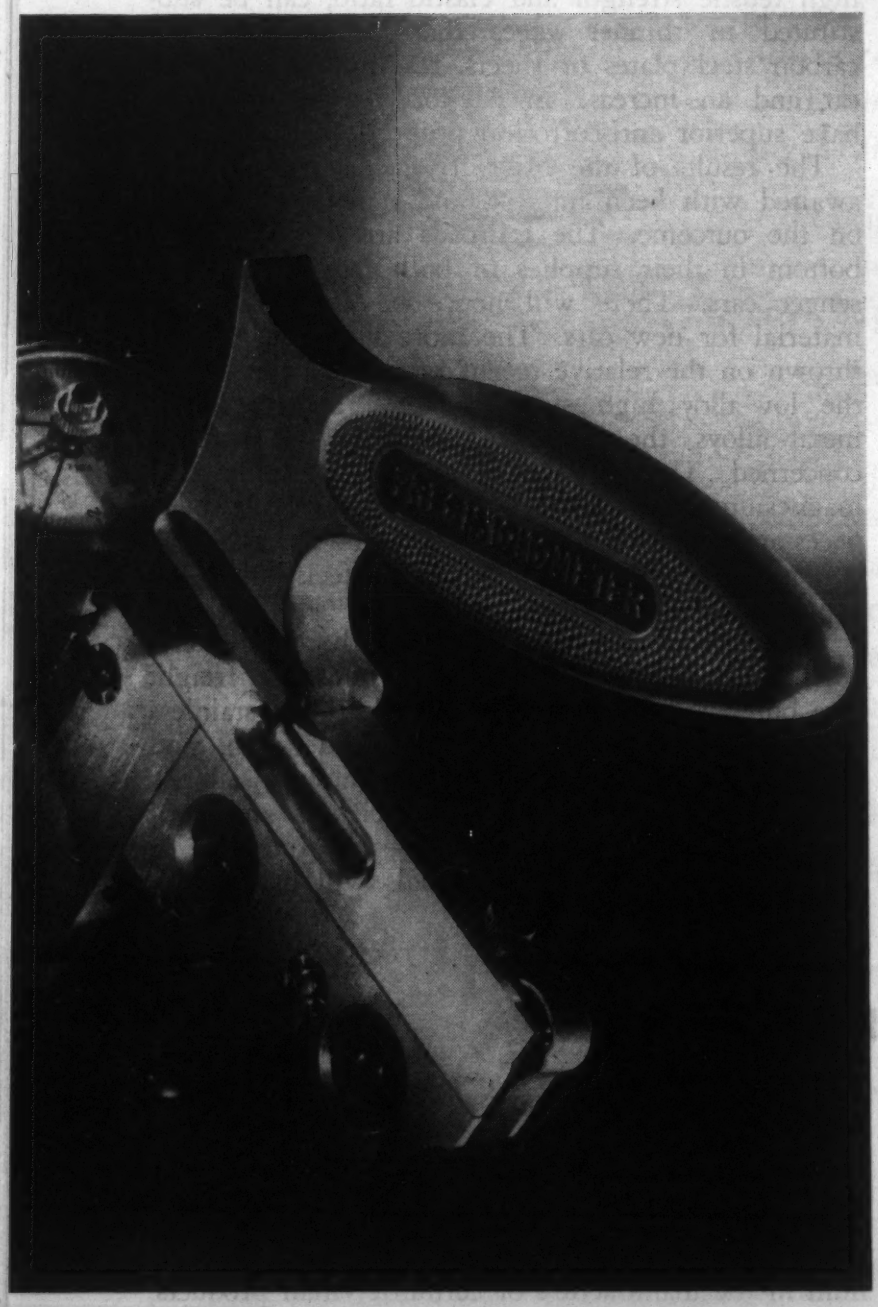
Maybe you can get a little for development work and model-building, anyway. Why not try? —F.P.P.

Plastics and Metals

—Competitors or Collaborators?

by G. K. SCRIBNER

President, Boonton Molding Co., Boonton, N. J. and President of the Society of the Plastics Industry



An excellent example of metals-and-plastics collaboration is this portable indicating comparator. The handle is injection-molded of Tenite plastic, whose low thermal conductivity prevents the heat of the operator's hand from affecting the precision of the metal measuring components. Courtesy: Tennessee Eastman Corp.

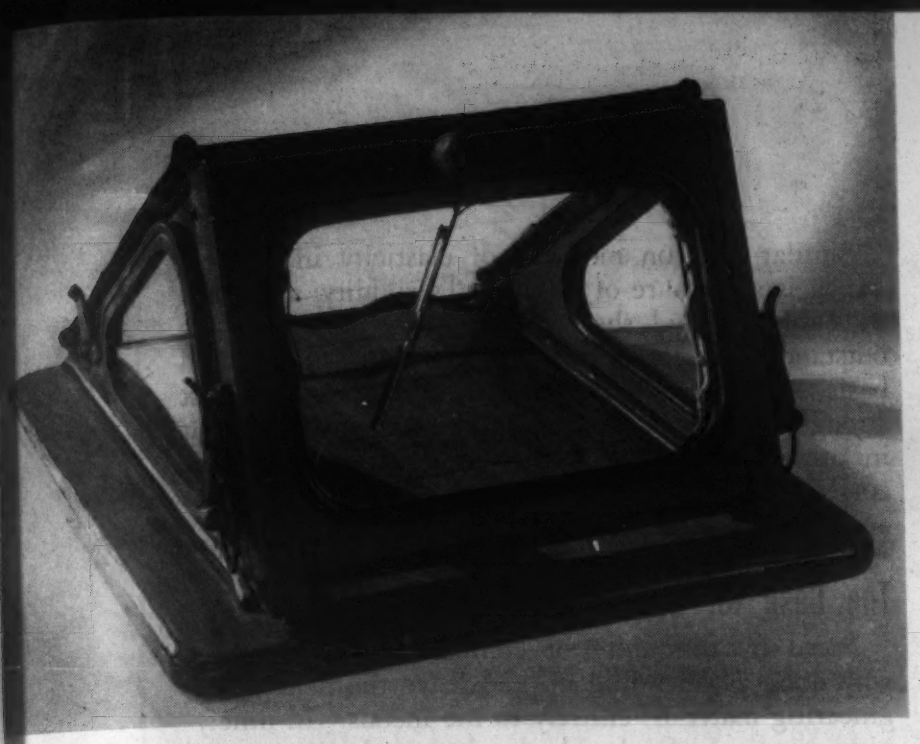
Not as a threat to metals nor as temporary substitutes for them but actually as complementary materials, plastics have been permanently added to the group of materials with which the engineer once concerned exclusively with metals must now work. It is a pleasure, therefore, to present from so high an authority in the plastics industry as Mr. Scribner this open-eyed analysis of the "competitive" relationship between plastics and metals in the field of product design—an analysis that simply and clearly shows the engineering and styling advantages and disadvantages of each and their probable future fields of competition and collaboration.

—The Editors

ANY ATTEMPT TO COMPARE plastics and metals on a competitive basis is difficult because of the versatility of both groups of materials. It is in the same class with the ancient discussions of which is the more valuable man on a base ball team, a good hitter or a good pitcher. Both are necessary to a well-rounded team. Our team in this case comprises all the materials of engineering that are making possible the present and future scale of living for all of mankind.

The general idea that plastics will in some way be competitors of metals (especially light metals) in the post-war world may be true to a certain extent, but the areas of overlapping will be found to be comparatively small. In the first place, plastics are not a tonnage industry as practically all metals are. Even magnesium, the newest candidate among the metals is being produced at something like double the entire output of plastics. If the automotive world suddenly decided that plastics cars were actually here and tried to swing into production, it would put the chemical industry in an impossible situation. Three hundred and fifty thousand tons of plastics (the present production for parts) would not go very far, and the tanks, retorts and piping required to jump plastics production up to anything approaching the tonnage required would be a real headache.

Even in the competitive area, the rivalry is not general. Molded plastics compete with metal chiefly when metals are die-cast, sand-cast or machined.



Injection-molded Fibestos plastics parts are combined with metals in this tank windshield assembly. Courtesy: Monsanto Chemical Co., Plastics Div.

Laminated plastics are competitors with metals when the latter are considered in sheets, formed or machined. Resin coatings compete with metals used as plating mediums. These are the three principal occupants of the twilight zone where plastics and metals overlap.

Outside this area the two types of materials are "mutually exclusive"—each supreme in its own right. Plastics cannot be used where continuous heat above 400 F. will be applied. Plastics lack the surface hardness of most metals, although many plastics seem to be better under abrasion than many metals. Again, if only a small space is available and the cross section therefore limited, metals are invariably chosen because they provide the requisite strength.

Some Broad Distinctions

Plastics are beyond the competitive reach of metals where (1) satisfactory electrical insulating quality is required; (2) a material is needed that will waterproof textiles so as to leave them flexible enough to use as raincoats, shower curtains and the like; (3) transparency is required; (4) a material is sought that is suitable for protection against ordinary heat conduction in such simple applications as coffee pot handles, gas stove handles, electric-iron handles and thousands of like parts; (5) the material must feel warm and comfortable to the touch, so that one's skin won't freeze to it in cold weather, and must not get too hot to handle in very hot weather; and (6) a choice of built-in colors is desired.

If those were the sole bases of comparison between plastics and metals, metals would already be at the start of a long decline. However the problem cannot be settled so simply in favor of either side. Let us go back to the two most important fields where the choice may be difficult—formed metals versus molded plastics and sheet metals versus sheet plastics, and see if it is not necessary to draw some finer distinctions.

To begin with, not all metals can be formed with equal ease. As with plastics compromise is usually invoked. A certain alloy steel may be ideal as to service quality but to get it in the shape needed might involve so much cost as to make its specification unwise. If some bright engineer found an airplane propellor design that needed a metal so hard to work that it would cut the entire propeller production of the country to one tenth its present rate, it is unlikely that the advantages accruing from its use would be considered enough to justify the loss of production.

Molded plastics need rather expensive steel molds, but so do metal die-castings. Sand-cast metals offer a cheaper approach, but may leave too much machining to be done to get the needed accuracy. Plastics molded parts seem to fit into a middle band of accuracy. If the part is really rough and a sixteenth of an inch means nothing a sand casting is certainly indicated; if the tolerances, however, are less than 0.001 in., carefully machined metal is a better choice; between these two sections is where molded plastics may have an even chance.

Other things being equal, the greatest advantage plastics have to offer the prospective buyer is built-in color, and its twin brother, surface permanence. In the case of plastics neither corrosion nor electrolysis will alter what was bought and paid for.

Die-cast or stamped metal is most certainly indicated when thin sections must be rigid or bear any appreciable strain. Strong thin plastic parts can easily be made in limited shapes by using reinforcements of laminates or fibre stocks, but they will not be rigid. On the other hand plastics can carry threads very nicely, as nicely indeed as metals if there is enough "meat" around the thread to prevent its cracking out.

Engineering Factors in Selection

Basically the first factor determining the choice of plastics or metals is the available space or volume of the part. If it is relatively small, plastics are almost automatically out unless their use is demanded by one of the 6 "exclusives" mentioned earlier.

After the space factor comes cost. All plastics cost more than metals, on a pound basis. The saving grace for plastics comes from the advantage of their low specific gravities (see Table I). Even magnesium at 1.80 is higher than the average range of 1.06 to 1.50 for plastics. Perhaps, indeed, a correction of the usual strength values for the specific-gravity effect may bring plastics up into the range of the engineering metals. Unfortunately, to make any showing at all for plastics we must choose the very best plastics material, and be careful to select one of the weaker alloys for comparison.

On this basis for instance, let us make some tensile strength comparisons (see Table II). Chrome-moly steel and stainless steel run around 180,000 p.s.i., aluminum alloy 62,000 and magnesium alloy 46,000. One of the strongest plastics we have is Pregwood, impregnated plywood. Pregwood's tensile strength is 30,000 p.s.i. Other "strong" plastics are paper laminate at 12,500 p.s.i., canvas laminate 9,500 and wood-flour-phenolic molded parts at 8,500. It is evident that plastics offer no competition in direct comparisons of this type.

Table I. Some Plastics and Metals Compared as to Light Weight (lightest at the top of the list).

Materials and Characteristics	Specific Gravities
Formica Pregwood No. 100. Impregnated compressed wood. All laminations parallel. Classed as a high strength product. Water absorption 6% maximum.	1.30
Formica canvas laminate-phenolic. Grade C. Cotton fabric—4 oz. per yard. Tough. Water absorption 0.3%.	1.33
Formica paper base laminate-phenolic. Grade X. Primarily for mechanical applications. Water absorption 4.0%.	1.33
Bakelite wood flour phenolic BM-120—best all round molding composition. Water absorption 0.3%.	1.36
Bakelite macerated canvas phenolic BM-3510. High production, high impact molding. Water absorption 1.0%.	1.38
Formica glass mat base phenolic Grade MF. Basically for electrical purposes. Water absorption 0.35%.	1.50
Formica asbestos fabric base laminate—Grade AA. Strength — toughness — minimum dimensional changes. Water absorption 1.5%.	1.80
Magnesium alloy (AM-585).	1.81
Aluminum alloy (24 ST).	2.80
Stainless steel.	7.85
Chrome-moly steel.	7.85

Now suppose we set up our system of handicaps based on dividing the strength figures by specific gravity so we can determine specific tensile strength or tensile strength per pound (again see Table II, in which the materials are listed in their order of merit in this respect). Immediately one of the plastics contestants, Pregwood, moves up to third on the list at 23,000, behind magnesium alloy at 25,400, and stainless steel at 23,600. Chrome-moly steel comes in at 22,900, aluminum alloy at 22,100, and then a terrible drop to paper laminate at 9,400, canvas laminate at 7,100 and wood-flour-phenolic, molded, at 6,200.

This comparison shows that if the competition be confined to sheet materials, the plastics stand up fairly well in tensile strength by weight, but the moment it centers about really shapeable forms by bringing in the moldable group, the plastics lose position rapidly.

With respect to compressive strength the steels are strongest; with some of the plastics better than some of the other metals, as can be seen in Table III. When the specific gravity correction is applied, however, all the plastics (except Pregwood, now) rate higher than the metals. Therefore if compressive strength is the determining factor in a specific design, plastics (some form of thermosetting phenolic or urea) will serve the purpose best pound for pound.

Similar data on modulus of elasticity in tension, which is a measure of a material's rigidity, are given in Table IV and show clearly that the metals are outstanding in this respect, even on a per-pound basis. And beyond that, on shear strength, impact strength and flexural strength there is just no point in presenting tables, no matter how they might be corrected for comparative weights, for the plastics are woefully inferior to metals in these respects.

The Case for Plastics

Faced by this story of comparative performance why don't plastics fold up and leave the field of engineering materials entirely to the metals? In ninety-nine cases out of a hundred, when a plastic material is faced with a really severe service application of an engineering nature it does fade right out of the picture—unless the stronger metal has its own handicap (such as poor resistance to corrosion or even electrical characteristics) that may be even more serious than the mechanical deficiency of the plastic.

Fortunately for plastics there are enough applications for which any material will have enough strength if it can be dropped six times from the height of a table to a concrete floor without breaking. Certainly if you can design around compressive strength almost any kind of thermosetting plastic material, except plywood, will give the best results on a pound basis. Under tension plywood is right up in the front fighting it out with the leaders in the metal world on a pound-for-pound basis, asking no quarter and giving none. That is the reason the famous Mosquito bombers are made of plywood (actually a different kind of wood for each part of the structure, birch in one spot, boxwood in another, etc.).

Plastics have a few outstanding service qualities where these previously mentioned measures of strength are not all-important. One of these is abrasion resistance. Ammunition chutes of laminated phenolic outwear steel. Plastics gears are not only quieter but wear as well as steel. Under impact plastic

Table II. Comparison of Strength/Weight Properties of Plastics and Metals.

Material	Specific Gravity	Tensile Strength	Tensile/S.G.	Ratio (magnesium alloy = 100)
Magnesium alloy	1.81	46,000	25,400	100
Stainless steel	7.85	185,000	23,600	93
Pregwood	1.30	30,000	23,000	90
Chrome-moly steel	7.85	180,000	22,900	90
Aluminum alloy	2.80	62,000	22,100	87
Paper laminate	1.33	12,500	9,400	36
Glass fabric laminate	1.50	14,000	9,300	36
Canvas fabric laminate	1.33	9,500	7,100	28
Wood flour phenolic, molded	1.36	8,500	6,200	24
Asbestos paper laminate	1.80	10,000	5,500	21
Impact phenolic molded	1.38	7,500	5,400	21

Table III. Compressive Strength/Weight Values of Plastics and Metals.

Material	Specific Gravity	Compressive Strength	Comp. Str./ Spec. Gr.	Ratio (canvas laminate = 100)
Canvas laminate	1.33	38,000	28,000	100
Paper laminate	1.33	35,000	26,000	93
Glass fabric laminate	1.5	40,000	26,000	93
Impact phenolic, molded	1.38	35,000	25,000	89
Wood flour phenolic, molded	1.36	30,000	22,000	78
Asbestos laminate	1.80	38,000	21,000	75
Magnesium alloy	1.81	35,000	19,300	69
Chrome-moly steel	7.85	150,000	19,100	68
Stainless steel	7.85	150,000	19,100	68
Aluminum alloy	2.80	40,000	14,300	51
Pregwood	1.3	15,000	11,000	39

sheets won't dent and gradually deform before failure, but just break all of a sudden, while metal, although it will not fail completely, will get battered out of any usable shape. Plastics will dampen vibration better than metals, too, which means less noise, or the avoidance of synchronous beats set up in other parts of a machine.

Sheets of plastic cannot be drawn to new shapes as easily as metals, but usually when odd shapes are wanted they can be created in plastics before making the sheet itself; in other words, sheets of metals are raw materials suitable for a great deal more working than sheets of plastics. The plastics man starts one step back of the sheet, uses the same basic material and pre-forms it to the desired shape instead of into the sheet itself.

There is one unfortunate characteristic of plastics that occurs also in metals but not so badly, and that is creep. Creep (cold flow in this case) is the constant change in dimension under stress. The thermoplastic plastics are strongly subject to it and therefore are avoided for stressed service; in the thermosetting materials creep is present but unless the material is used with practically no factor of safety it may be discounted entirely.

Classes of Plastics

In any comparison of plastics and metals it should be remembered that there are many types and forms of "plastics." All plastics are divided into thermosetting and thermoplastic types. The first group, the thermosetting, are somewhat like concrete in their internal action. As raw materials they will first soften under heat and then harden. Practically no further softening will take place right up to the charring point. A part once molded wrong might as well be scrapped, since the material cannot be used over again. (Like all technical statements that one must immediately be qualified. It has been reported that the H. J. Heinz Co. of 57-variety fame developed a liquid that would soften a completely cured phenolic part, than which there is no more completely set item thinkable, so that the part could be manipulated by hand, and would come back to its original hard state when dried. Also, some of the airplane companies on the west coast have a process whereby they can shape within certain limits laminated structures that have been considered completely cured. With those reservations our definition of thermosetting is still good.)

The thermoplastic materials, the other general class of plastics, are those which have the quality of softening under heat and hardening when cool; a simple analogy in this case is paraffin.

The thermosetting group are usable on an average up to around 300 F.; some will go to 400 F. The moldable materials that go above those figures are based on cement binders as a rule and are not classed as plastics. Thermoplastic materials, as a rule, are not rated much above 130 F. although the laboratories promise some that can be boiled, for production in the near future.

There is one outstanding characteristic about metals that we who handle plastics regard with wistful envy. The word "metals" covers a number of different materials and everybody accepts that fact without question. So does the word "plastics," but few people seem to recognize *that* fact. Perhaps an illustration will make significance of this statement clearer:

Suppose the hardware stores stocked ordinary house gutters of two or three different kinds of plastic materials, and that John Doe decided to buy one and bought the cheapest he could find—to be specific, one made of cellulose acetate. On an August day in Philadelphia it would probably sag from the heat and become useless. The odds are that he thought of the gutter as "plastics" rather than as *an acetate plastic,* and when it proved unsatisfactory he would simply condemn all plastics and decide never to buy another plastics gutter.

On the other hand, suppose he bought a cheap black iron gutter and in three or four months that gutter rusted out. Again the odds are that he would merely scratch his head and admit that he should have known better and bought a copper gutter in the first place. He definitely would not have condemned *metal* gutters.

The moral is that we to whom plastics are bread and butter have been lax in educating the public to

Table IV. Moduli of Elasticity in Tension and Specific Gravities of Plastics and Metals.

Material	Specific Gravity	Modulus of Elasticity	Modulus /S.G.	Ratio (stainless = 100
Stainless steel	7.85	30×10^6	3.8×10^6	100
Chrome-moly steel	7.85	29	3.7×10^6	98
Aluminum alloy	2.80	10.4	3.7×10^6	98
Magnesium alloy	1.81	6.5	3.6×10^6	94
Pregwood	1.30	3.7	2.84×10^6	75
Paper laminate	1.33	3.0	2.25×10^6	59
Glass fabric laminate	1.50	2	1.34×10^6	35
Impact phenolic, molded	1.38	1.8	1.30×10^6	34
Canvas laminate	1.33	1.5	1.12×10^6	29
Asbestos laminate	1.80	1.5	0.84×10^6	22
Wood flour phenolic, molded	1.36	0.96	0.70×10^6	18

Pregwood — resin-fused wood laminations — comes closer to the metals in tensile strength than the other plastics. When made into propellers the material is combined with metal edges to improve service life. Courtesy: Formica Insulation Co.

the fact that there are a whole series of plastic materials, each of which has a different set of qualities, so that if a wrong application is made of one of the series (and there are bound to be mistakes made) the whole class of plastics will not be condemned. We should begin that education with engineers and then try to make it filter down to the general public. Unfortunately, even some engineers disparage plastics generally because they made a mistake in the choice of one of the line.

Specific Materials

A recitation of the many branches of the plastics family tree may help to clarify the possibilities of future applications and their relations to metals. The two basic classifications of thermosetting and thermoplastic are merely behavior classifications. First let us remember that plastics are the children of organic chemistry—permutations and combinations of the five elements carbon, hydrogen, oxygen, nitrogen, and chlorine, with minor assistance from many others.

The top division among plastics would group them into rigid and non-rigid, rigid plastics being those which require substantial force to deform, and which show only a moderate deformation under the stress of usage. This would probably mean an elongation in tension of less than 100% and possession of appreciable flexural strength. These are the general class of materials meant when we talk about plastics. The materials that lie outside the rigid group are the elastomers such as the Bunas, Butyl Thiokol, Neoprene and the like.

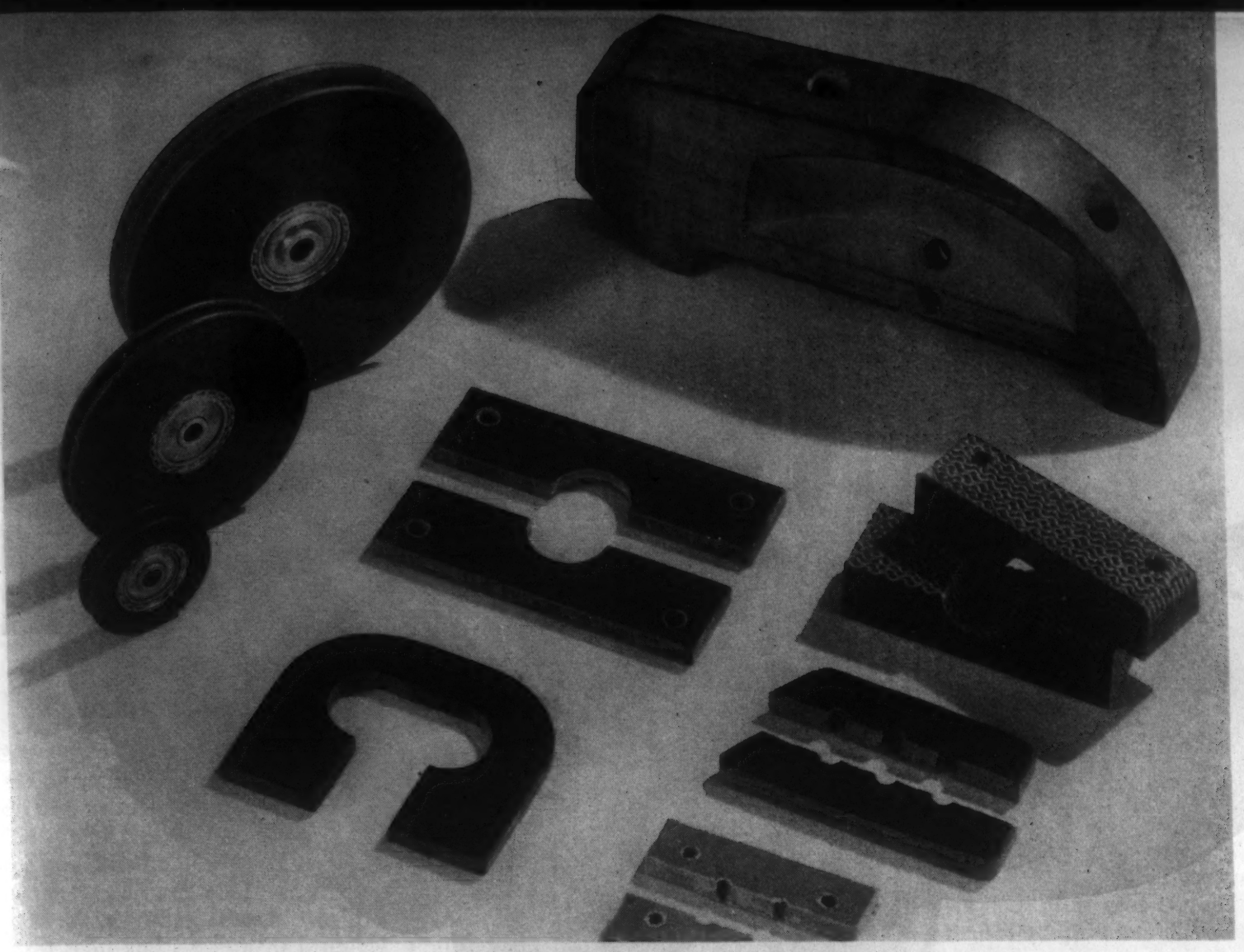
The rigid plastics may then be divided into three general groups, the thermosetting resins, the thermoplastic resins and the cellulosic. Even after that breakdown we should perhaps recognize a fourth and straddling group of "natural" plastics to accommodate such materials as lignin, casein, cashew nuts, redwood, coffee and such.

Among the thermosetting resins there are phenol-formaldehydes (commonly called phenolics), phenol-furfural, urea formaldehydes, and melamine formaldehydes. They are all furnished to the molder or laminator in a preliminary state of chemical change and are completed or cured by the heat applied in the forming operations. A chemical reaction takes place in the mold so that when they come out of the mold or laminating press they are different chemically from the materials that went into the presses. Each will maintain its new identity indefinitely if properly treated.

The thermoplastic group is the one that constantly fills the headlines and carries most of the glamour today. It is the one that furnishes the shoe soles, the shower curtains, the transparent food packages and so on. In it are the acrylates of bomber-nose fame, styrene, polyethylene, Nylon, vinylidene chloride and the vinyl family—a most versatile group of chemical relatives who can do almost anything, including belonging to either the thermosetting or thermoplastic class at the command of the chemist in charge.

Then comes the cellulosic section, made up of cellulose acetate, cellulose nitrate (the forefather of them all, but a frequent problem because of its inflammability) cellulose acetate butyrate, and ethyl cellulose, one of the latest comers. These are not resins, but compounds. Each has been loaded down with a lubricating agent, of which the chemist has a list of a couple of hundred at his finger tips.

Finally there is that catch-all class, the naturals. Nature uses the same general formula that the plastics industry uses. All things inanimate that grow consist of a filler (cellulose) and a binder (some sort of lignin). That binder has tempted the chemist mightily ever since plastics became good headline materials. Coffee, soy beans, cashew nuts, walnuts, redwood, all have been found to have possibilities. All seem to contain something resembling aldehydes or phenols in their composition. They have been successful in coatings and in large sheets for wall boards but the basis formula is not consistent enough to show any particular promise in molding.



These aircraft pulleys, fairleads, propeller supports and cabin air controls are fabricated from laminated plastics. Courtesy: Bakelite Corp.

Plastics and Metals as Partners

If the field of competition between plastics and metals is small, the question naturally comes up as to whether metals and plastics should merely pass each other by with a nod. Definitely not. The main use of plastics today and in the future is complementary to metals.

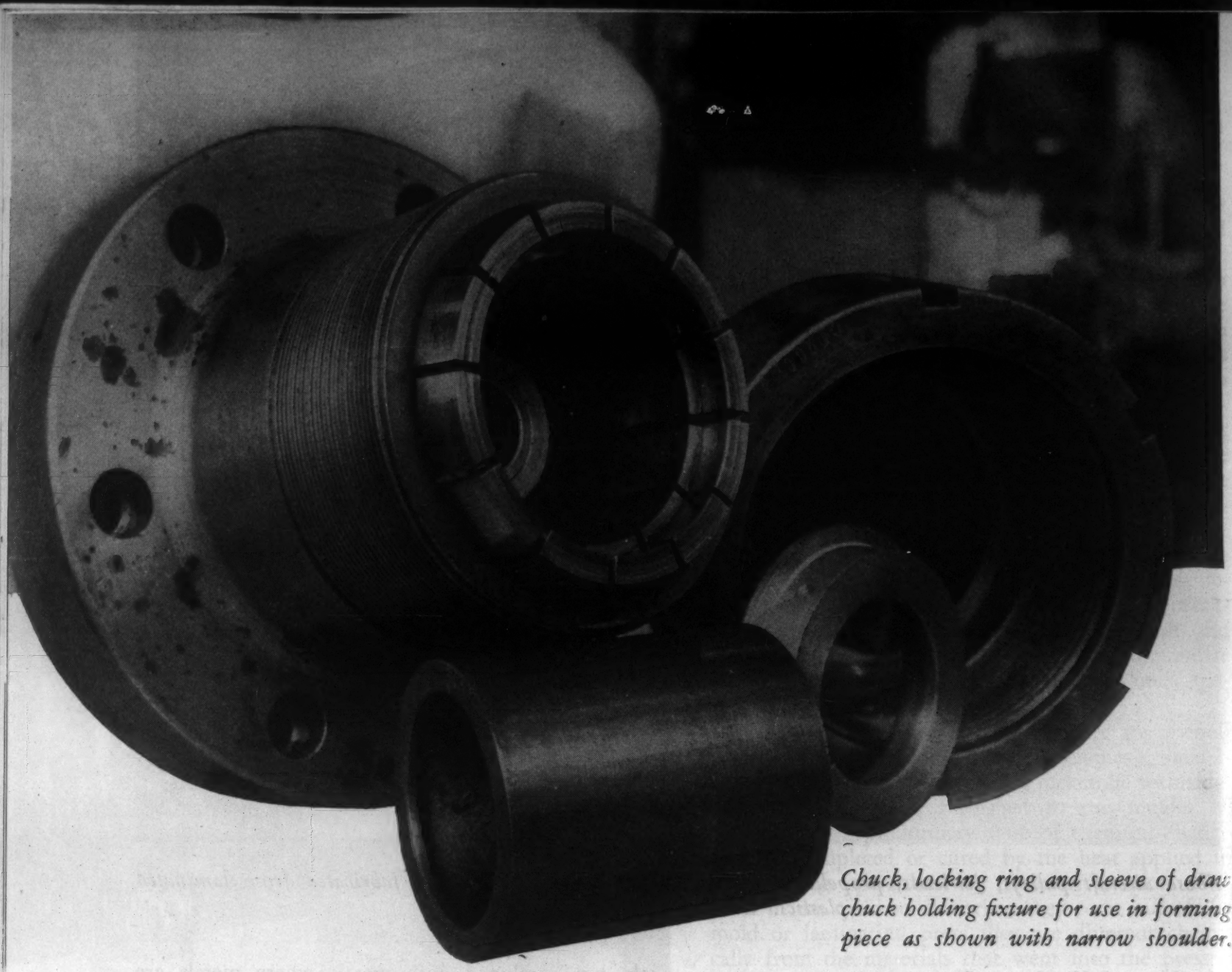
Plastics must add to metals the characteristics that metals lack, and they are already doing just this in many surprising ways. Plastic quick drying varnishes put the automobile into the low price class it had to hit if it wanted volume. Remember when it took weeks to finish a repaint job? Busy weeks too, on the part of the painter, weeks spent in rubbing down successive coats and careful drying in between. Now the dipped or spray sections are dried progressively in tunnels. Imagine, if you can, thousands of cars per day under the old system.

In automobile hardware we have the ideal illustration of the combination of desirable qualities in metals and plastics—die cast zinc alloy cores for door handles covered with thermoplastic colors, warm to the touch and everlasting, the strength and rigidity of the die cast metal counteracting the tendency of the plastic to droop in heat or under too much pressure. Business machines of all kinds have metal bases for rigidity, metal gears for small strong sections, and plastic parts for complications and housings. Plastics can handle electricity but welcome metal for protection and for the boxes that are fastened to the wall. Airplanes have hundreds of plastics parts, where the light weight really does a job, but combined with metals where metals are helpful from the strength standpoint. The list of such combinations is endless.

I recently saw an all-plastic alarm clock, a completely illogical try if ever there was one. The combined cost of molds and molded parts would have placed the selling price at four or five times that of any much better metal clock. And yet there are good reasons for clock cases finished in plastics. Color, the low cost of intricate shape, warmth to the touch, etc. in combination with the basic metal design make a salable article.

In considering plastics as design-materials, therefore, please remember two things. First, there are many plastics, just as there are many metals; if one plastic does not prove the answer to your problem, look around a bit and see if there isn't another that is more logically suited. Second, include plastics in your design thinking as a complementary material to your metal experience; investigate every possibility of combining a metal and a plastic to utilize the best features of each.

The very fact that plasics production is only 350,000 tons per year compared to the relatively enormous production figures of metals (90 million tons of steel, 1 million tons of aluminum, etc.), tied to the widespread discussion of plastics in the public press and in engineering magazines like this must mean only one thing: No material with that small volume could get around enough *on its own steam* in the last five years to make the impression that plastics have already made; the explanation is that the most important applications of plastics have been in combination with their bigger brothers, the metals.



Chuck, locking ring and sleeve of draw chuck holding fixture for use in forming piece as shown with narrow shoulder.

Ammunition-Hoist Parts Efficiently Machined

An interesting example of several ways in which sound engineering practice has invaded the field of machining, with attendant improvement in the general efficiency of machine-tool use, are the machining operations performed by Busch-Sulzer Bros. Diesel Engine Co., St. Louis, on various parts for Navy ammunition hoists. Here machine-tool selection is made a function of the engineering, design and performance requirements of the particular part to be manufactured. Some of the jig and fixture work is ingenious and is responsible for large savings in time and materials. This article, the first (we believe) to be published on ammunition hoists, is one of several "advanced practice" stories Mr. Stedman is preparing for METALS AND ALLOYS *in the course of a nation-wide tour of metal-working plants.* —*The Editors*

by GERALD ELDRIDGE STEDMAN

THE UNITED STATES NAVY has made one of the most complex but practical applications of calculus in solving the problem of ammunition hoists, with particular reference to the 5-in. antiaircraft gun.

Here is an example of the resolution of combat variables into a single application of this equipment: An enemy bomber at an absolute altitude of 20,000 ft., traveling at 250 m.p.h., let us say, is sighted by a U. S. cruiser which recognizes it to be making ready for dive-bombing attack. To protect itself, the cruiser in its zig-zag course and with the pitch and toss of sea, must meet this air bomber at the vertical start of his dive at a probable 10,000-ft. altitude, with

a hoist of sufficient ammunition, accurately placed, to demolish the attack.

This target is so high-flying and so small, that shrapnel is used rather than bullets, the powder to explode and the metal to spray being hoisted in a shell, fitted with a fuse, designed to burst within a 100-ft. target area. There is the problem of setting the fuse on each shell, firing many shells per minute with all variables changing each thousandth second.

Diving speed, for example, is 450 m.p.h. (600 ft. per sec.). The cruiser's fire control station is perhaps 100 ft. from the gun. Means and methods of calculating from this distant control point, while the shell is in the hoist, require calculated precision that is bewildering. An infinitesimal fraction of an error would cause the shell to burst off target. The cruiser and its crew might be lost.

The Navy has calculated, designed, built and is using equipment, so successfully answering this problem that the Japs have already been panicked in the Pacific. The ammunition hoist is being built by Busch-Sulzer Brothers Diesel Engine Co., St. Louis, in a Navy-owned plant and with Navy equipment. Edward B. Pollister, company president, accompanied by O. W. Pfeffer, works manager, speeded to Washington in 1940 with rolls of blueprints, figured with others, and was low bidder (some other estimates ran 400% higher—one large concern refusing to estimate).

In short order, Busch was producing, with the plant built and equipment installed. Pollister stepped up production on Pearl Harbor day to a three-shifts, seven-day schedule, and accelerated production over 400%. Most Busch workers haven't been off a day since. The company has had its fourth Navy award for excellence. Last November, W. H. P. Blandy, Rear Admiral, U. S. N. Chief of Ordnance, wired: "The performance of twin ammunition hoists for 5-in. antiaircraft guns in service aboard a U. S. light cruiser recently in action reflects great credit upon you who built them."

The Ammunition Hoist shop is under the superintendence of J. A. Hess, a master mechanic and formerly of Rock Island Arsenal.

Materials and Operations

The main parts of the ammunition hoist are: (1) Fuse setters, (2) upper head assembly, (3) small gear boxes. In all, there are some 750 parts, some very intricate. The flow is from sub-sub to sub-, to final assembly. The greatest portion of the metal used is phosphor bronze, Navy 46 B5 steel, SAE 1020—45, and cast steel.

Phosphor bronze, a copper-tin alloy containing about 0.10% P, is a hard, fine grained yellow colored metal of great toughness and high tensile strength. Red brass (approx.: 87% Cu, 3% Zn, 7% Sn, 3% Pb) is now being substituted for it in some parts. There have been other changes to conserve critical metals, to increase man-hour production and effect significant cost reductions or increases in efficiency.

Selecting part "X" (further definition restricted) which is machined from a rough of 200 lb. to a finish of 125 lb., hitting a tolerance of ± 0.0003 in. as typical of the 750 parts, and selecting the most interesting machining operations from its flow through 10 operations, the technique will be described as used on: (1) Heald bore-matic, (2) Gleason gear cutter, (3) Keller profilers, (4) Blanchard grinders.

There are 37 sets of jigs to accommodate operations on the Heald bore-matic, most of them of special Busch design. Four sets of bores, for example, are lined center-to-center to meet a tolerance of ± 0.001, achieving a hole size ± 0.0002. One Busch designed and built hexagon-shaped jig does six different parts, cutting down severely the number of separate fixtures. This work was formerly finished on a lathe because

Forming tool used with draw chuck shown in previous illustration.

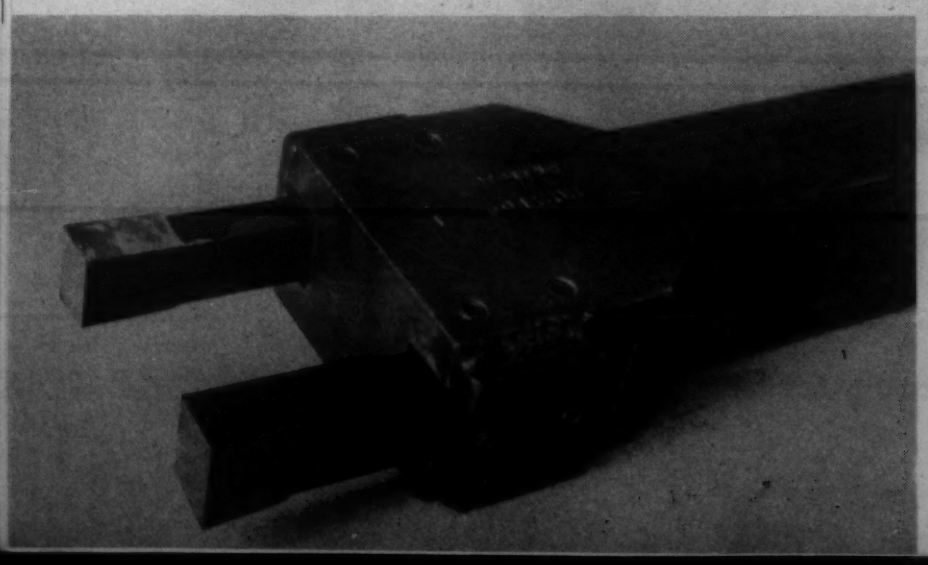
Special tools designed to face inside bosses of casting in one setting. These designs allow substitution of cold-rolled in place of frozen steel for shanks.

of problems of machining ball bearing pits. The present hexagon jig has cut down time and tool cost over 400%.

Gleason gear cutter operations employ standard equipment except for special arbors set up to obtain accurate cone distance. Work spindles are set on center. Such tooling as arbors and testing equipment is Busch designed after close study. One of the main effects has been to enable constant running at top speed. A small amount of stock is left for lapping. All gears in the final assembly must perform perfectly free without any backlash whatever.

Keller profilers have extended limit stops, thus gaining 12 in. horizontal and 3 in. vertical. This enables the accommodation of the largest casting requiring profiling work, doing all other milling on the same side. This particular casting has two grooves which are chain guides which are profiled in a continuous curve for 60% of the length.

Close up of special tool to face two large inside bosses of casting shown in previous illustration.



The casting is built around, requiring a very flexible machine to recover it. A special end mill is used which has enabled increasing feed from 4½ to 24 in. and the cutters are run considerably faster. Both widths and depths are cut simultaneously in one operation by flour flute mills; two to the wide and two to the narrow dimension. This practice permits holding to size without grinding to a sharp corner, there being about a 35% helix increase by this method. There is an abundance of chip clearance, as a result.

The Blanchard grinder fixture is a cylinder with 24 V's around its periphery, with a groove in the center. It is of standard surface grinder fixture design; achieved by milling and pasting down on a magnetic chuck. The fixture was designed from a foundry-defective casting to grind ends on plungers. It was necessary in this work to leave enough length to carry the center for cylindrical grinding after hardening, removing the bulk of surplus afterwards by abrasive wheel on a cut-off grinder.

The operations involved are: (1) Hang pieces on the shoulder and grind one end, (2) plungers are turned over on the same fixture and located on the previous ground end, enabling maintenance of shoulder length relationships and overall tolerances. Attendant photographs show closeups on many of these Busch ammunition hoist machining techniques and illustrate the shop spirit of attempting constantly to outstrip itself.

Tool Designing

John Graber, in charge of tools and equipment, has designed many tools in his 27 years with Busch. One undercutting tool, for example, is used for bottom tapping of a hole in a casting. The work to be accomplished was too clumsy to swing on a lathe or boring mill. Busch had previously used a technique of rough cutting on a boring mill. The difficulty was to put the work on a lathe to cut one hole. The problem was finally solved by an arbor carrying this movable tool holder that controls the diameter of the undercut. The action is accomplished with the tool in position, using the plus feed of the milling machine by means of the roller, shown in an accompanying illustration.

There are many other evidences of Busch tool designing ingenuity, such as a center locating procedure by a series of pins, accomplished by squaring the outside faces, effecting a 300% speed-up.

Recently, Busch has done away with many forged steel tool shanks or solid forged tools. Now, SAE No. 1045 is used, and tool bits are inserted. This saves 99% of critical tool steel, greatly lowers tool costs, creates time savings in maintenance and tends to increase tool efficiency.

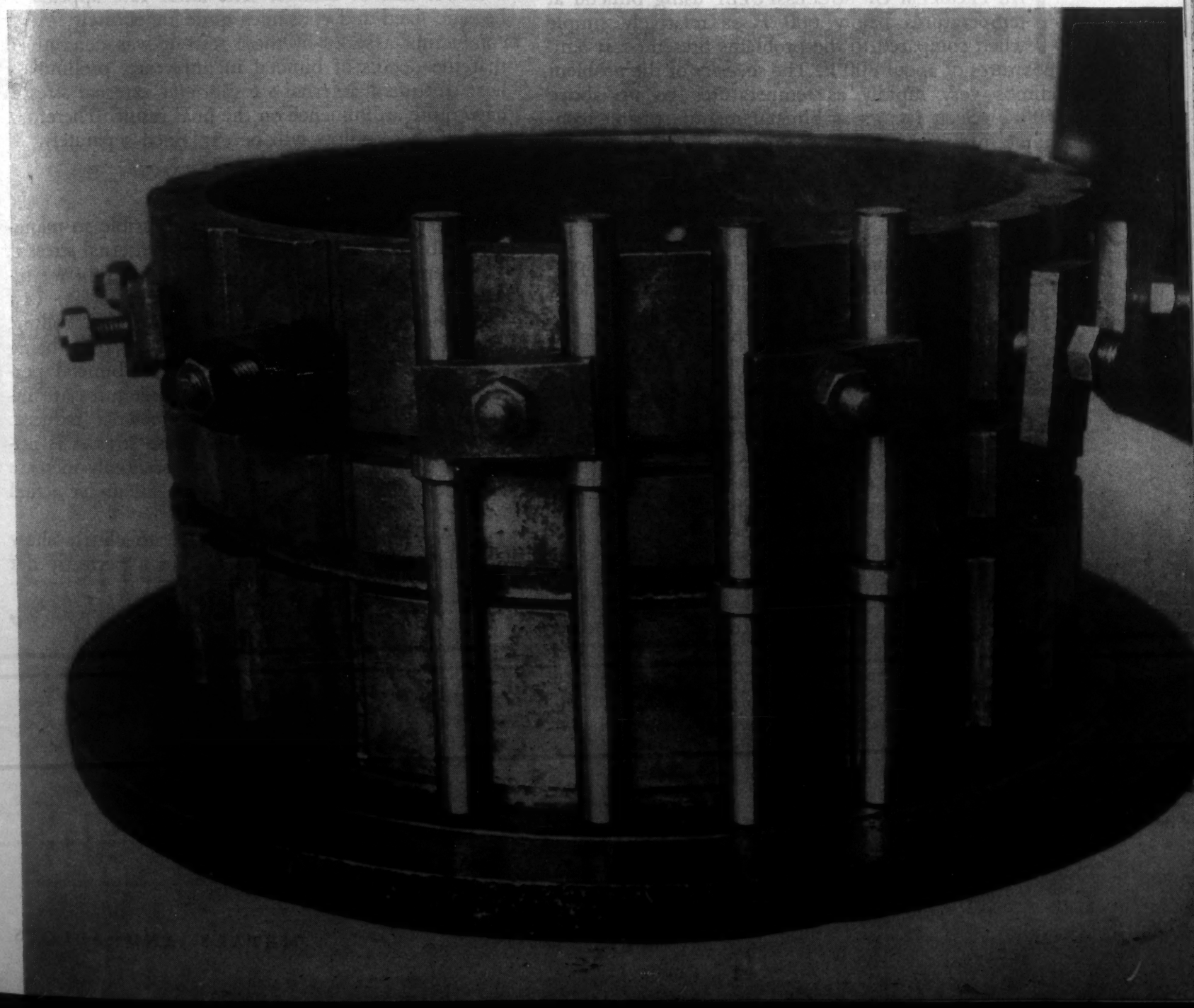
Another time saving of 600% has been accomplished through the design and use of a special tool

Undercutting tool used on milling machine to undercut below thread.

arrangement for facing of six bores in a clutch housing; four spaced 4 in. and two, 6 in. apart, which accomplishes in two operations that which formerly required six. The slotter table requires no changing, as formerly. The job is centered under this tool and remains there until the job is finished, the tool moving back and forth past the work. The shop is one of unusual ideas, ingenuity and precision. Everyone concerned is a spirited contributor.

Busch fabricates and makes final assembly of all ammunition hoists within this Navy owned and equipped building. It has not yet had a single rejection of a completed hoist.

Blanchard fixture (made from defective casting) set up for two operations—on left, grinding one end to correct dimension from shoulder; on right, grinding to correct overall length.



Bimetal Performance at 800 F.

by P. R. LEE *Westinghouse Electric & Mfg. Co., Mansfield, Ohio*

Thermostatic bimetals, generally employed at temperatures below 600 F. in dozens of electrical, mechanical and thermal control devices, are also widely and increasingly used for thermostatic devices in which the bimetal temperatures may reach 800 F. Few engineering data on bimetal performance at these higher temperatures have heretofore been available. Designers and engineers will therefore welcome this report, which describes a test method and results for bimetal at 800 F. and discusses the effect on service performance of manufacturing methods, prior heat treatment and internal and external stresses.

—The Editors

THE PROBLEM OF SUCCESSFULLY using bimetal at temperatures below 600 F. is relatively simple when compared to the problems presented at temperatures of about 800 F. The severity of the problem climbs very rapidly as temperatures go up above 600 F. Such factors as bimetal manufacturing technique, preliminary heat treatment of the finished bimetal blanks prior to assembly, and both internal and external stresses become very important. Scaling or oxidization of the bimetal is also accentuated. At lower temperatures, details of manufacture and internal stresses are usually totally disregarded and preliminary heat treatment given only minor consideration.

To ascertain the behavior of bimetals at elevated temperatures, a special testing fixture was built whereby various bimetal specimens could be simultaneously tested at the same temperature for long periods of time. The bimetals to be tested were made up into small, narrow specimens as shown in Fig. 1. With the low expansion component on top and in a horizontal plane, one end of each bimetal specimen was solidly clamped to a rigid support. At the free end of the bimetals a fixed weight was suspended as in Fig. 2. This whole fixture was placed in a constant temperature oven held within plus or minus 2 F. of the specified operating temperature. About once a week the oven was cooled to room temperature, all weights carefully removed, and each bimetal specimen placed in a separate calibration fixture. Here the bimetals were accurately checked with micrometers for change of shape by measuring the shift in the free end of the bimetal.

The general relationship between time and change of shape for either a loaded or unloaded specimen is shown in Fig. 3. Note that in some cases the high component becomes convex while in others the high component becomes concave. The former condition usually exists on most commercial bimetals if unloaded, but can occur under light load conditions also. The latter condition can exist on some unloaded bimetals but is more representative of most bimetals with externally applied loads. The lower curve which shows a drastic change of shape is characteristic of heavily loaded bimetals.

Note that on most of the curves there is first a faster rate of change which eventually tapers off to a slower rate of change. The latter rate appears to become fixed and continues quite indefinitely. After conducting a series of these tests it was determined that the details of bimetal manufacture, preliminary heat treatment, internal stresses, and external stresses have quite an influence on the final result. Therefore, each of these points will be explained separately.

Bimetal Manufacturing Techniques

So far it has been practically impossible to manufacture bimetal absolutely free of any internal stresses. This is probably because during manufacture we introduce stresses in at least four different ways: (1) Constrained heating, (2) free heating, (3) rolling, and (4) bending. These stresses are far from being small and therefore do seriously affect bimetal performance, especially when high temperatures are involved where elastic limits are somewhat reduced. The direction and magnitude of these stresses is important because they may either substantially increase or decrease the stability of the bimetal under actual service conditions.

A very simple test can be made to clearly show what internal stresses are present in a perfectly flat

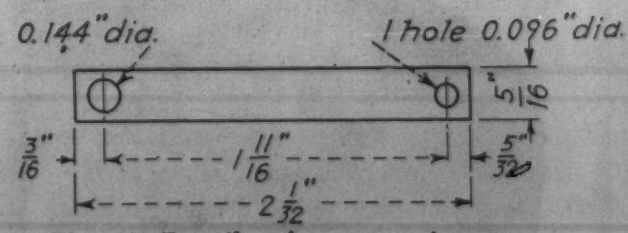


Fig. 1. Details of test specimen.

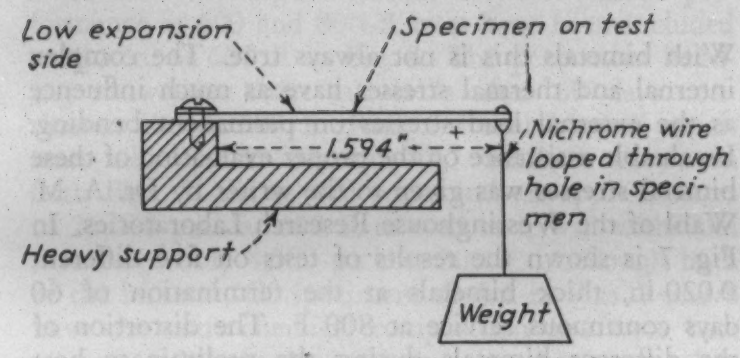


Fig. 2. Schematic of test method.

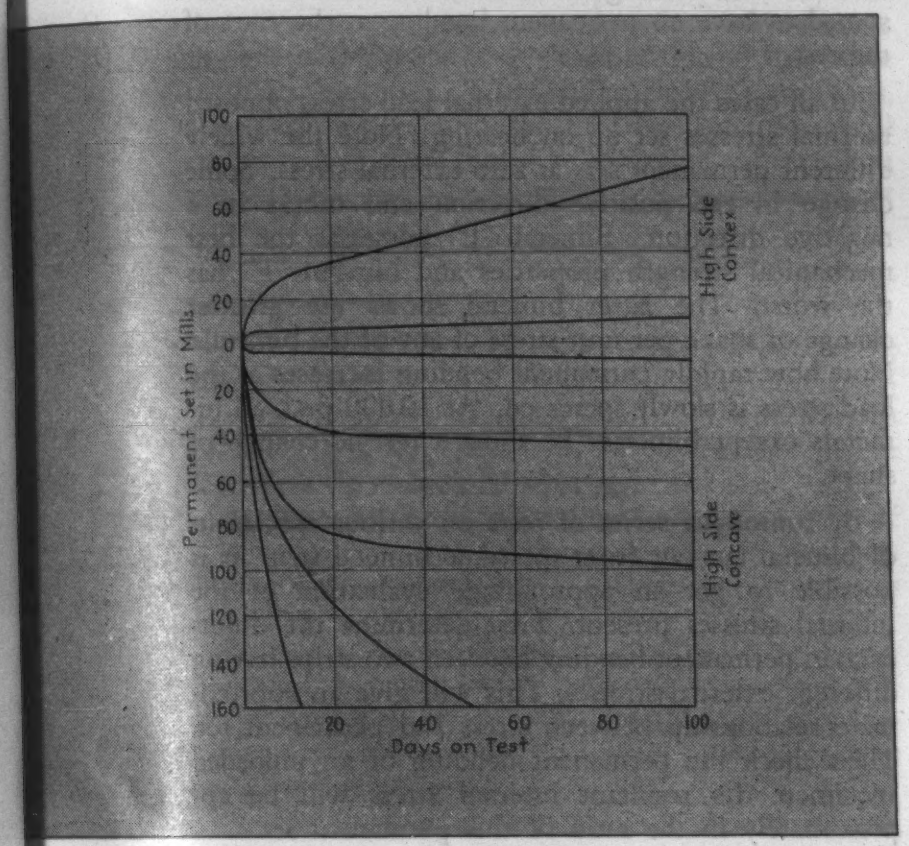


Fig. 3. Curves showing general relationship between time and change of shape for loaded and unloaded specimens.

piece of bimetal at room temperature. Dip the bimetal into a chemical solution which will completely dissolve either the high or the low component without in any way affecting the remaining component. In every case it will be found that the remaining component is not flat as was the composite material beforehand. Fig. 4 shows the resultant shape of one of the components in four entirely different bimetal alloys. All were removed from bimetals which were 0.020 in. thick and perfectly flat. Note the large degree of curvature that exists and how variable they are and also that some show stresses in an opposite direction to others. It is no wonder that bimetal manufacture is an important factor to consider.

Preliminary Heat Treatment

It has been a well-known fact that in low temperature applications, where bimetals are used as thermal actuators, better temperature stability is obtained if the bare bimetal blanks prior to assembly are simply aged at a temperature slightly in excess of their final intended operating temperatures. The importance of this aging or preliminary heat treatment depends on many factors. There are instances where its omission does not materially affect results and others where its omission means complete failure of the final product. However, at temperatures of 800 F., preliminary heat treatment is always very, very important.

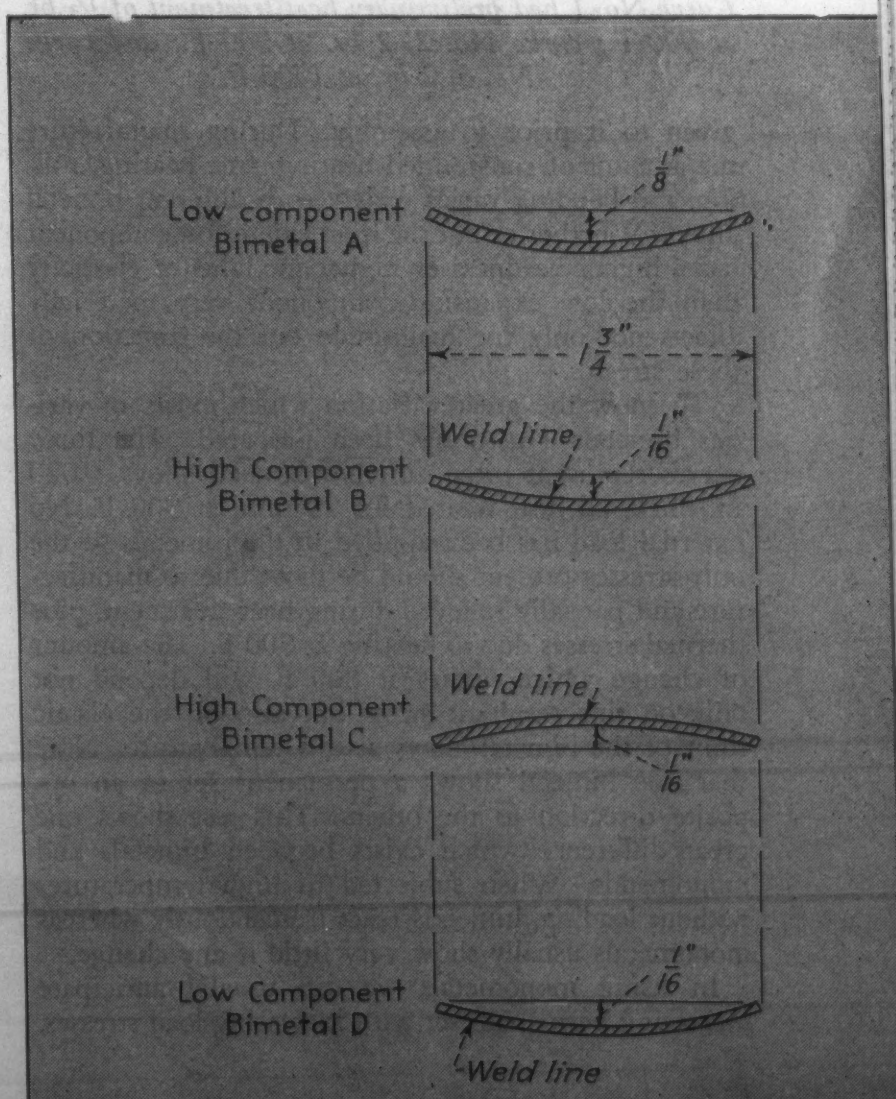
In Fig. 5 there is shown not only what happens to a piece of bimetal during heat treatment but also what effect this heat treatment has on the final performance of the bimetal at 800 F. when free of any externally applied stresses. The bimetal specimens for this test were cut out from the same bimetal strip, 0.020 in. thick, so the internal stresses originally present from manufacture should be approximately the same in each. Hardness, thickness, and thermal activity were identical. All permanent bending was in a direction tending to make the high expansion component concave.

Note the higher the heat-treating temperature, the greater the change of curvature during heat treatment. This is shown in Fig. 5 by the points at which the curves commence. Therefore, at the start of the 800 F. test, these bimetals already possess a great change of shape. However, also note that the bimetals receiving the greatest change during heat treatment received the least additional change at 800 F. continuous service.

Internal and External Stresses

The resultant internal stress existing in a piece of bimetal depends on its original manufacturing technique and the extent of cold work and heat treatment

Fig. 4. Magnitude of internal stresses existing in commercial bimetals.



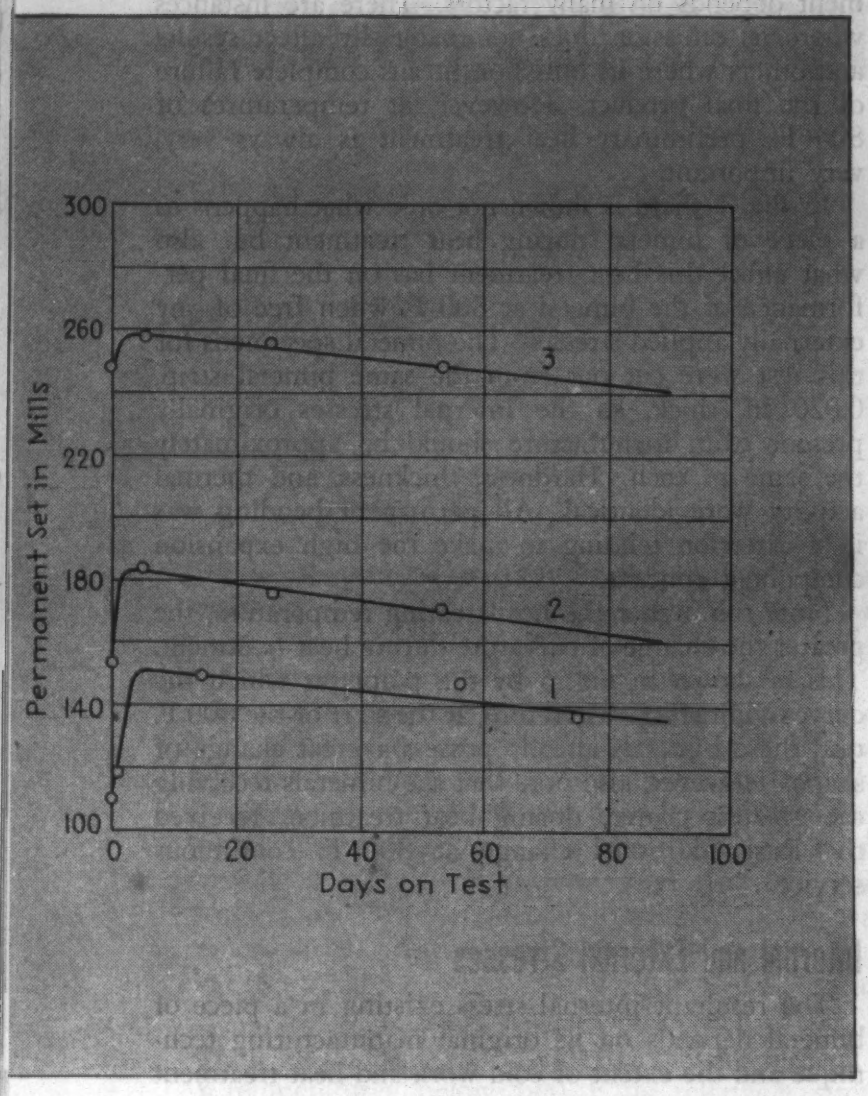


Fig. 5. Curves showing effect that preliminary heat treatment has on bimetal performance at 800 F. Curve No. 1 had preliminary heat treatment of ⅓ hr. at 900 F.; curve No. 2, 2 hr. at 900 F.; and curve No. 3, 2 hr. at 1400 F.

given to it prior to assembly. During manufacture the amount of constrained heating, free heating, rolling, and bending varies widely with different bimetal alloys. Whether or not the high expansion component has a higher hardness or higher modulus of elasticity than the low expansion component very materially affects not only the magnitude but the direction of these stresses.

To show the great variation which exists in various bimetals Fig. 6 has been prepared. The three curves represent three different bimetal alloys, 0.020 in. thick, all heat treated for 20 min. at 900 F. No external load has been applied to the bimetals so the only stresses present should be those due to manufacture and partially relieved during heat treatment, plus thermal stresses due to heating at 800 F. The amount of change which occurs at 800 F. will depend not only on this resultant stress but also on the elastic limit of the bimetal alloys at this temperature. Note that one bimetal shows a permanent set in an opposite direction to the others. This test shows one great difference which exists between bimetals and monometals. When subjected to high temperatures without loading, bimetals react tremendously whereas monometals usually show very little if any change.

In using monometals we can usually anticipate increasing permanent set with increasing load stresses. With bimetals this is not always true. The complex internal and thermal stresses have as much influence as the external load stresses on permanent bending. Invaluable assistance on the proper evaluation of these bimetal stresses was given to the writer by Dr. A. M. Wahl of the Westinghouse Research Laboratories. In Fig. 7 is shown the results of tests on five different 0.020-in. thick bimetals at the termination of 60 days continuous service at 800 F. The distortion of the different bimetals during the preliminary heat treatment was disregarded so all bimetals were assumed to have no permanent bending at the start of the test.

In all cases the applied external load stress opposed thermal stresses set up on heating. Note the widely different permanent sets at zero external stress. Some change in the positive direction and others in a negative direction. Bimetal "E" possesses the best mechanical strength properties and bimetal "F" has the worst. The latter bimetal shows the greatest change of shape per unit stress of any of the bimetals. Note how rapidly permanent bending increases as the load stress is slowly increased. At 10,000 p.s.i. all bimetals except bimetal "E" show a terrific change of shape.

By running a series of tests on various specimens of bimetal cut out from the same bimetal strip, it is possible to get an approximate evaluation of the internal stresses present. First determine the difference in permanent bending between two strips having different external stresses. This will give an approximate relationship between stress and permanent set. Then check the permanent bending of an unloaded specimen. Its resultant internal stress will be approximately in the ratio of this permanent set.

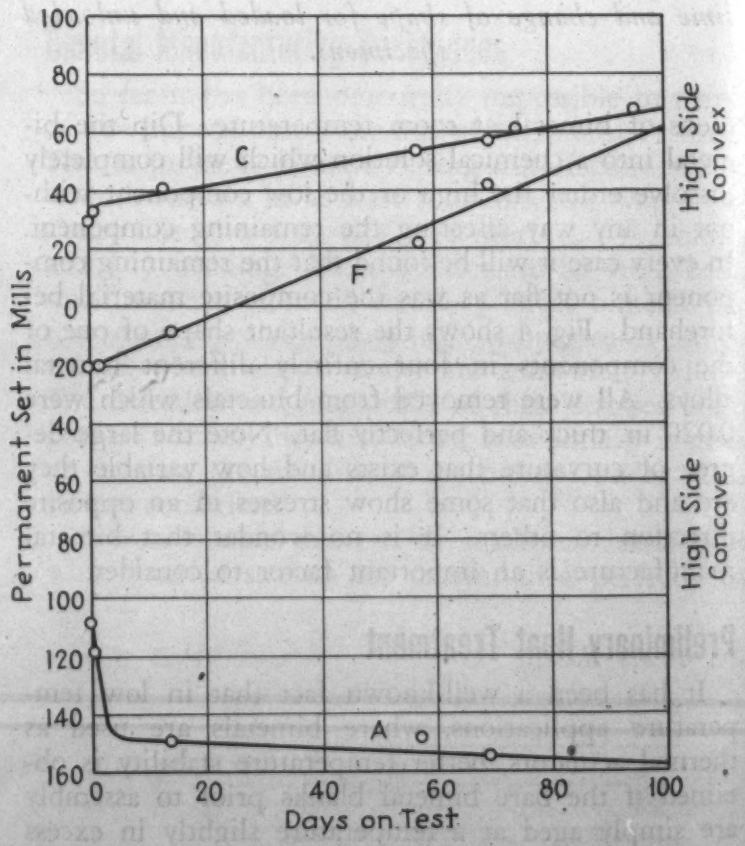


Fig 6. Curves showing how differently three bimetal alloys react to the same preliminary heat treatment and operation at 800 F.

To show the large difference between bimetal performance at 600 and 800 F. tests have been included conducted at 600 F. in Fig. 8. The permanent bending shown on these curves is after 60 days continuous use at 600 F. Four different bimetal specimens are shown. Bimetal "G," which is shown in both Figs. 7 and 8, will withstand an applied stress of 25,000 p.s.i. at 600 F. as well as it will withstand a stress of only 4,000 p.s.i. at 800 F. Although both of the bimetal "G" specimens shown in Figs. 7 and 8 have the same chemical composition and were heat treated in exactly the same manner, they were taken from two different bimetal shipments. This explains the difference in permanent bending which exists at zero external stress as possibly due to difference in internal stresses. When comparing the two tests, allowance must be made for this condition. All curves clearly show that a very marked difference in performance exists between 600 and 800 F. ambient temperatures.

Conclusions

1. Internal stresses in bimetals and the permanent changes which occur during preliminary heat treatment are extremely variable. Not only do the various bimetal alloys vary immensely but so also do different lots of the same bimetal alloy and thickness.

2. As either or both the time and temperature of the preliminary heat treatment is increased, the permanent set so created due to this heat treatment also increases.

3. Assuming a fixed heat treatment temperature and time, bimetals which show the most change of shape during this heat treatment also will show the most changes when used in service unloaded and at temperatures above 500 F.

4. On most commercial bimetals on the market, aging temperatures (free aging of bimetal) usually tend to cause a lowering of bimetal operating temperatures. This is because the high component tends to become convex. However, there are some notable exceptions.

5. If the heat-treating temperature is above the final operating temperature, then increasing either the time or the temperature of heat treatment tends to reduce the permanent set encountered in service. In many cases, if the time and temperature are increased sufficiently, the permanent set in service may be eliminated or even reversed in direction.

6. Most commercial bimetals will show less change in bimetal calibration if loaded slightly in an opposite direction to thermal stresses than if used without any external loading at 800 F.

7. Material improvement in bimetal performance at elevated temperatures is possible by using the maximum permissible bimetal thickness. Not only are load stresses themselves much less with a correspondingly major reduction in permanent bending, but changes in the free unloaded strip are also reduced.

8. The direction and magnitude of permanent bending at 800 F. in unloaded bimetals seems to be influenced by the relative hardness and relative modulus of elasticity of the two expansion components.

9. The proper selection of bimetal alloys and their heat treatment is very important when using bimetals above 600 F.

10. The maximum load stress to which bimetals should be subjected at any temperature depends on the maximum permanent set allowable. These tests indicate that if 25,000 p.s.i. has been used as the limit at temperatures of 600 F. or less, then a limit of about 4,000 p.s.i. should be used at temperatures of 800 F.

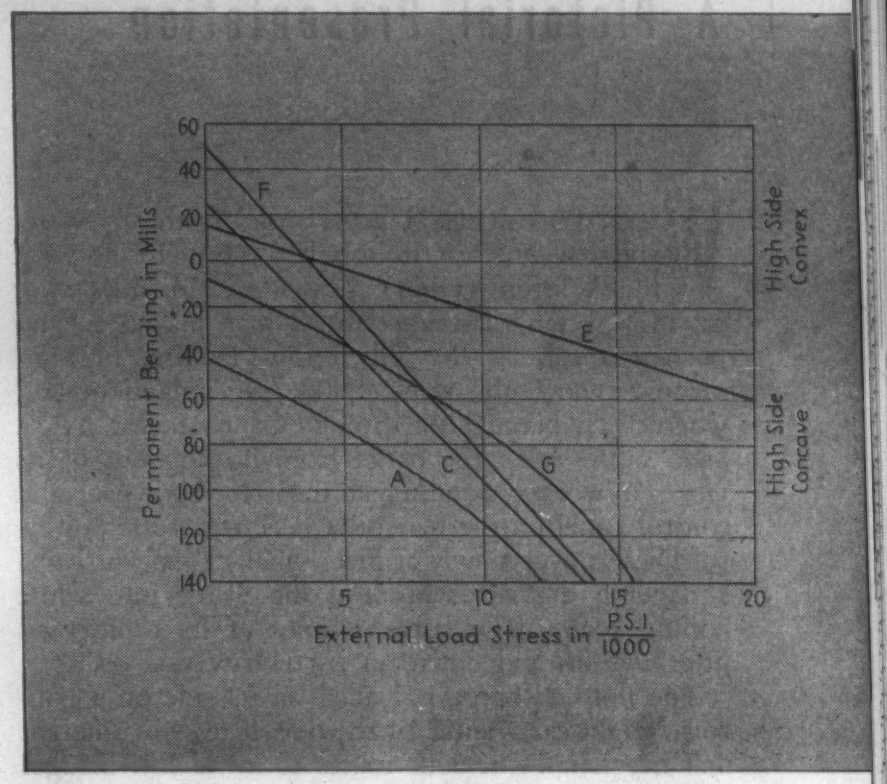
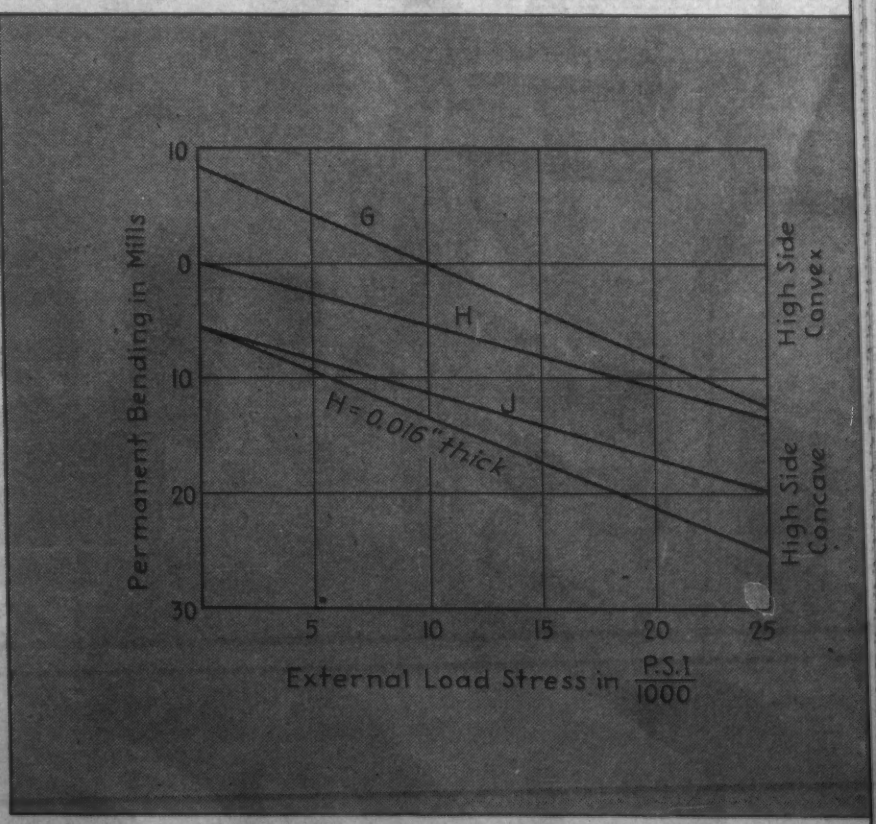


Fig. 7. Curves showing relationship between externally applied load stresses and permanent set at temperatures of 800 F.

Fig. 8. Curves showing relationship between externally applied load stresses and permanent set at temperatures of 600 F.



Bathtub-Tested Landing Barges

A Pictorial Presentation

WHEN YOU BUILD A BOAT miles from any water you have to test it in a bathtub. This is what the Warren (Ohio) City Mfg. Co. does with its LCM-3 tank landing barges that played so important a role in the "liberation" landing in Normandy. The "tub" is a 34,000 gal. "inland ocean," where each barge goes through its paces for 2 hrs. Steel cables keep the barge from leaping out of its tank. A worker standing at the steering wheel and control panel on the rear pilot deck turns the powerful Diesels over slowly at first—finally they whirl like a dancing dervish, whipping the water into white boiling foam. The barge whines at its cables and jitterbugs up and down on its own waves.

The finished barge is loaded on its side on a gondola freight car. Being 14 ft. wide, it reaches a height that necessitates devious routes to avoid low bridges and tunnels.

Warren City Mfg. Co. was organized Feb. 13, 1944, to purchase the 50-yr.-old Warren City Tank and Boiler Co. The plant was built and equipped by the Navy in 1942, costing $9,000,000. It is one of the most complete shops in the nation, designed for welding, fabricating, machining and assembling heavy types of equipment. Besides these landing barges, the company constructs destroyer and cargo drives, generator bases, and Diesel engine crankcases and bases.

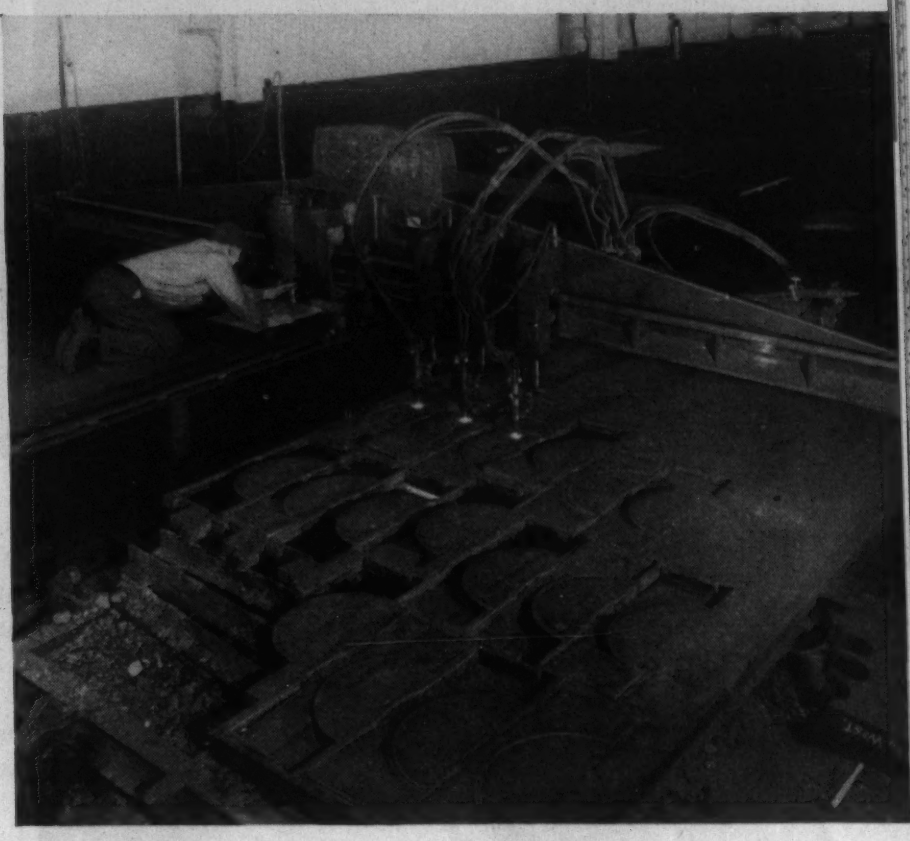
The plant comprises 225,000 sq. ft., employs 1700, of which 35% are women. The office building is entirely air conditioned. Joseph W. Frazer, president, was formerly president of Willys-Overland Motors, Inc.

So, let's get a pair of goggles and inspect the welding, put on rubbers to keep our feet dry around the "inland sea" and take a receptive mind into the Warren plant. —H. A. K.

We'll hastily get a bird's-eye picture of one of the main fabricating shops. Completed barges are 50 ft. long, 14 ft. wide and weigh 25 tons. They are Diesel powered.

Plate shears and flame cutting machines slice steel into proper sizes and shapes in this shop for parts preparation and preliminary fabrication.

This multiple-torch flame cutting machine follows a template or drawing and operates on the pantograph principle in slicing through heavy steel plate.

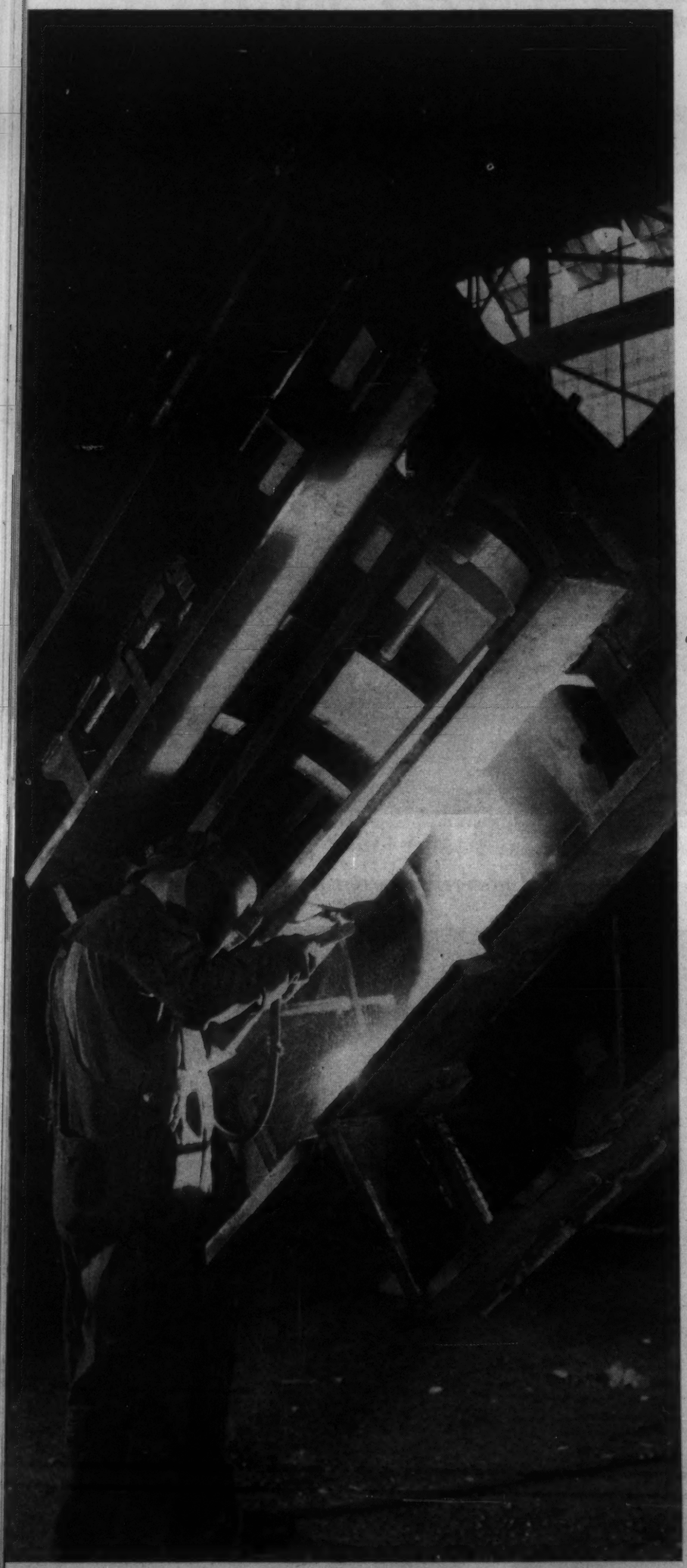


Part of a cargo drive and the base of a turbine cylinder are being prepared to enter the stress relieving furnace.

In this modern industrial X-ray room, work for many other industries in the Warren area is done. Equipment can photograph steel plate up to 4 in. thick for possible faults. The X-ray operated from the overhead crane is one of only four of its kind in the country.

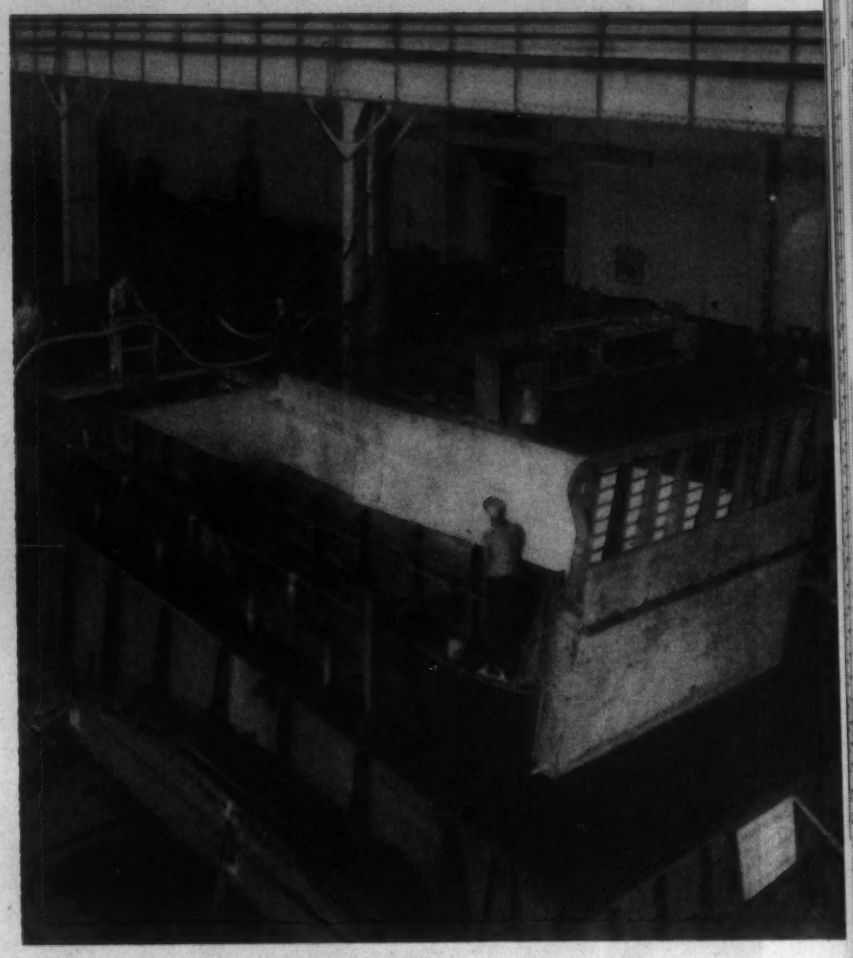
LCM-3 tank landing barges are constructed upside-down in special fabricating jigs on the assembly line. Here the entire stern assembly has been moved into position from its special assembly jig and work has started on the frame work and ribs.

Heavy weights hold the steel bottom plates down and in place until welding is completed. Landing craft carry the No. 1 priority for Navy construction.



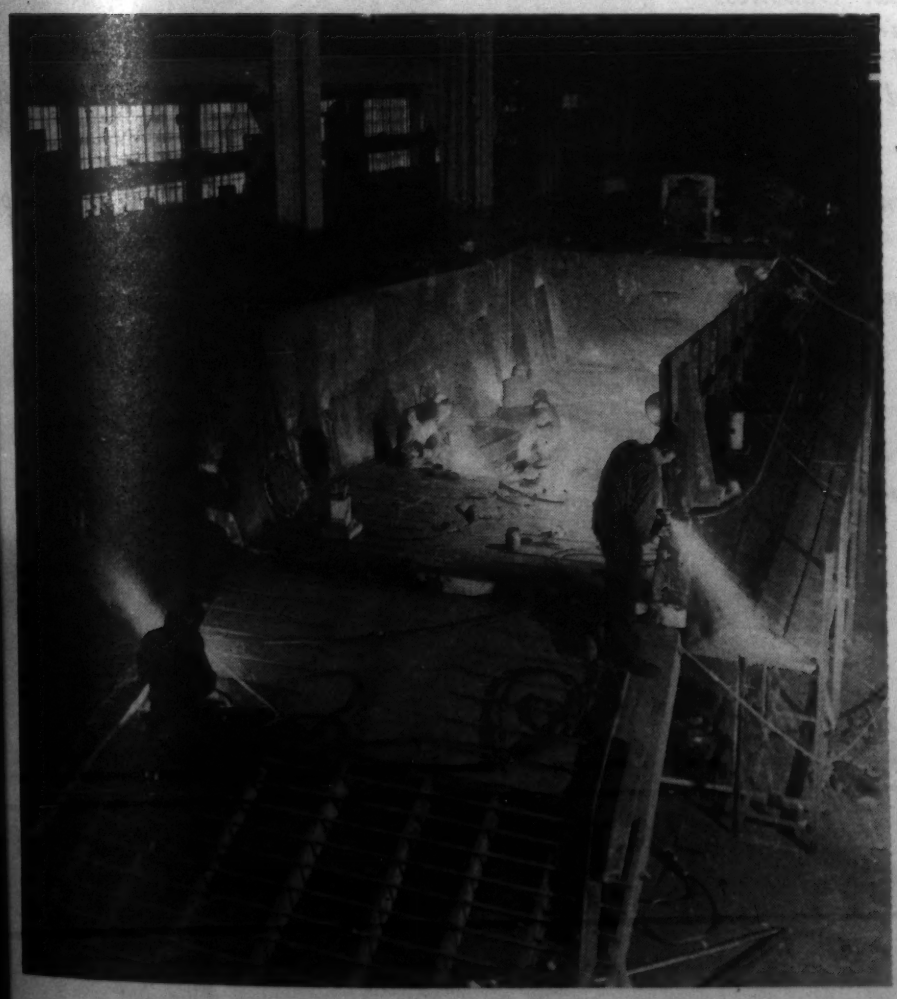
A special positioner holds a turbine cover for a welding operation.

After the shells have been constructed upside-down, they are turned over by huge cranes and deck plates are welded to supporting channels and beams in the well section. In the background installation of the control panel on the pilot deck is under way.

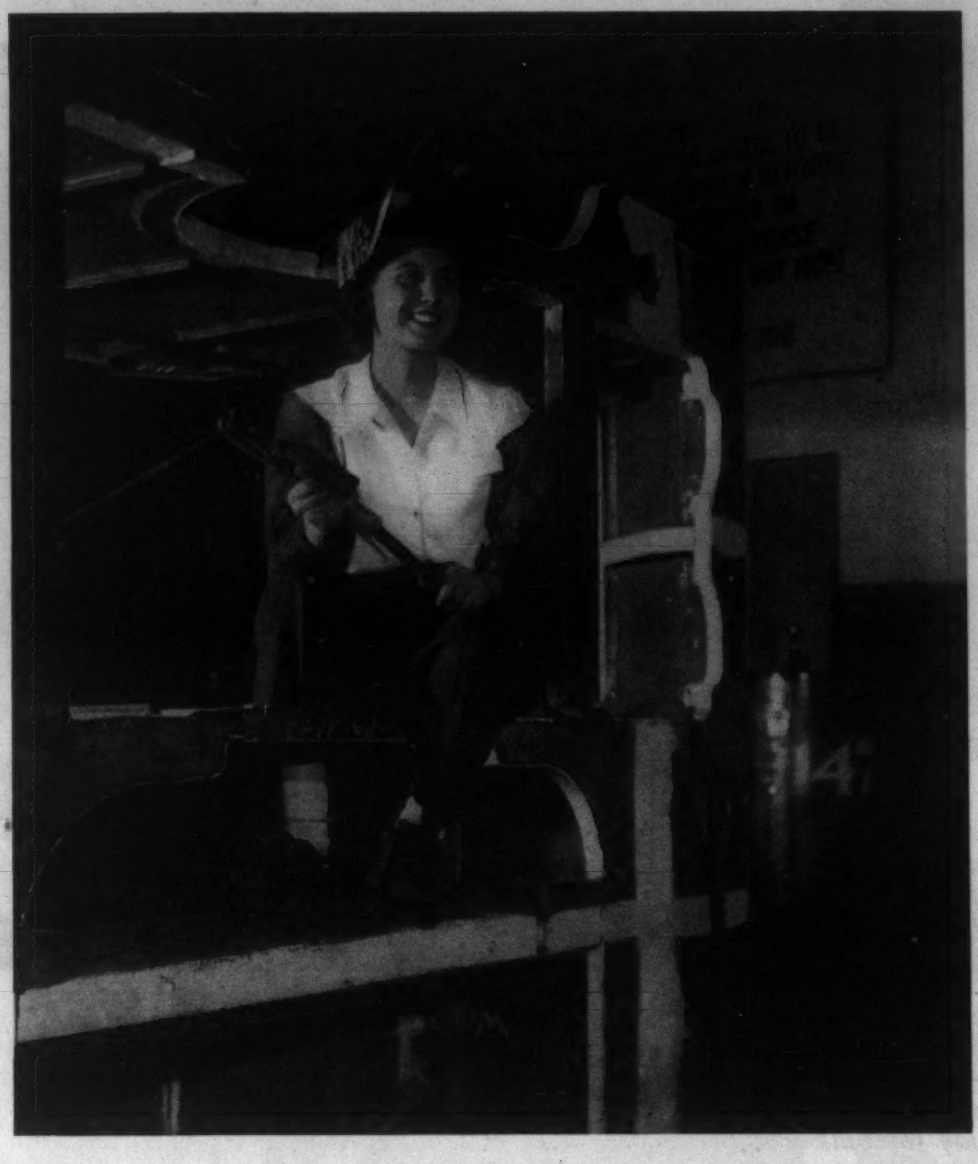


Here the barge is being tested in the "indoor ocean," as mentioned in our foreword. Meanwhile a woman near the landing ramp in the foreground has started cleaning for final painting.

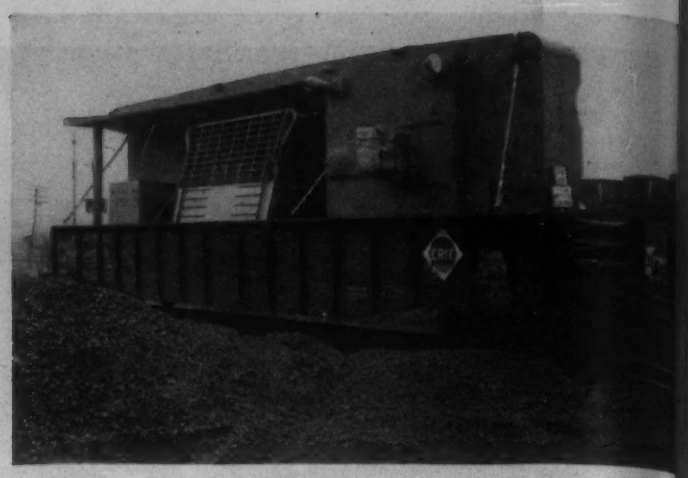
These huddled figures are not hobgoblins going through purification rites by fire—but rather women welders fabricating deck plates. A landing ramp is being installed. The barge is almost ready for bulkhead tests.



These young ladies are doing their laboratory work in the welding school. A very high percentage of the welders at Warren are Navy certified.



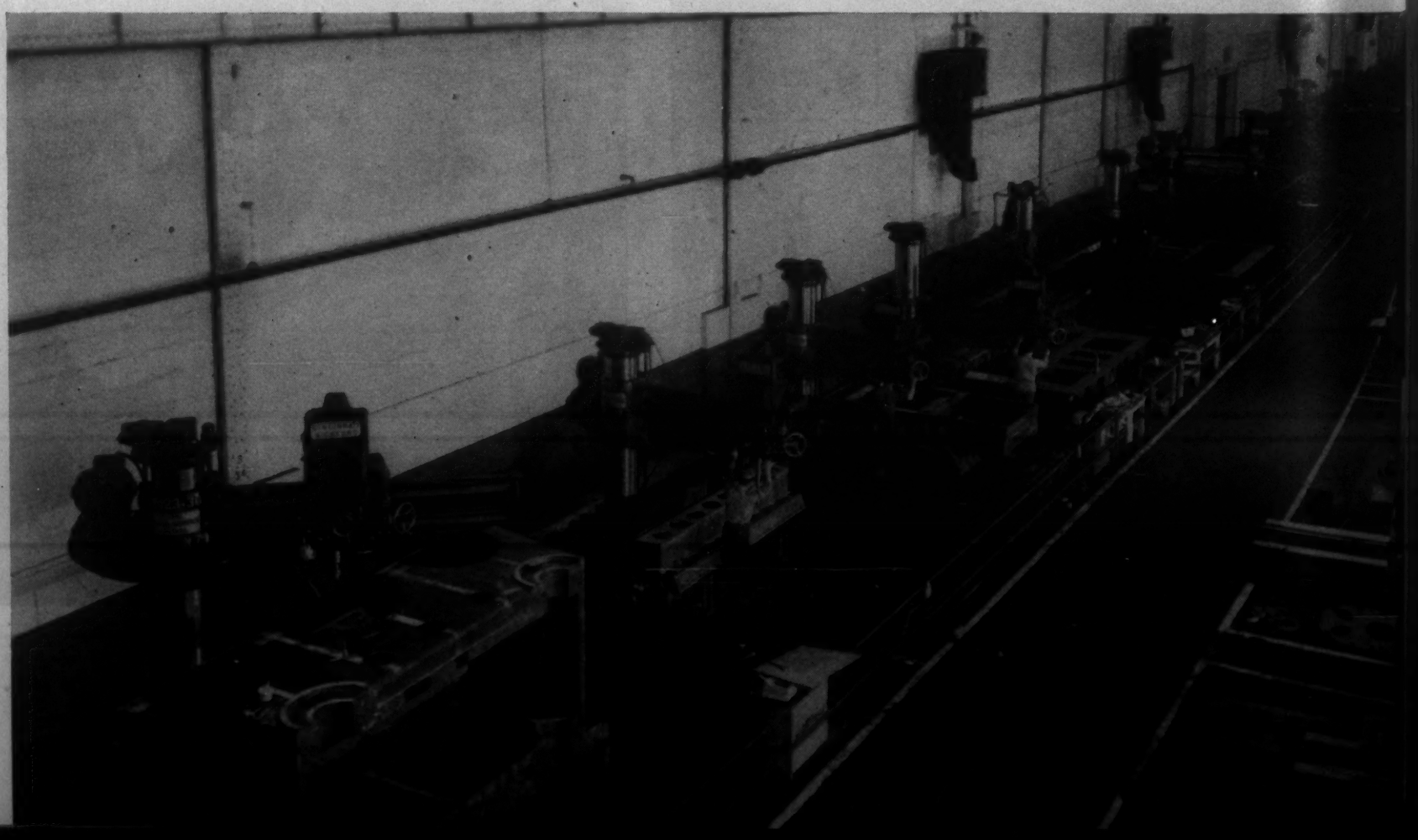
At first blush this might seem to be Miss Sabotage, judging by the sign in the background. Doubtless she does sabotage the concentration-on-work of the male employees! She is a graduate of the welding school—and, we should judge, was voted by her classmates: "Miss 1944."

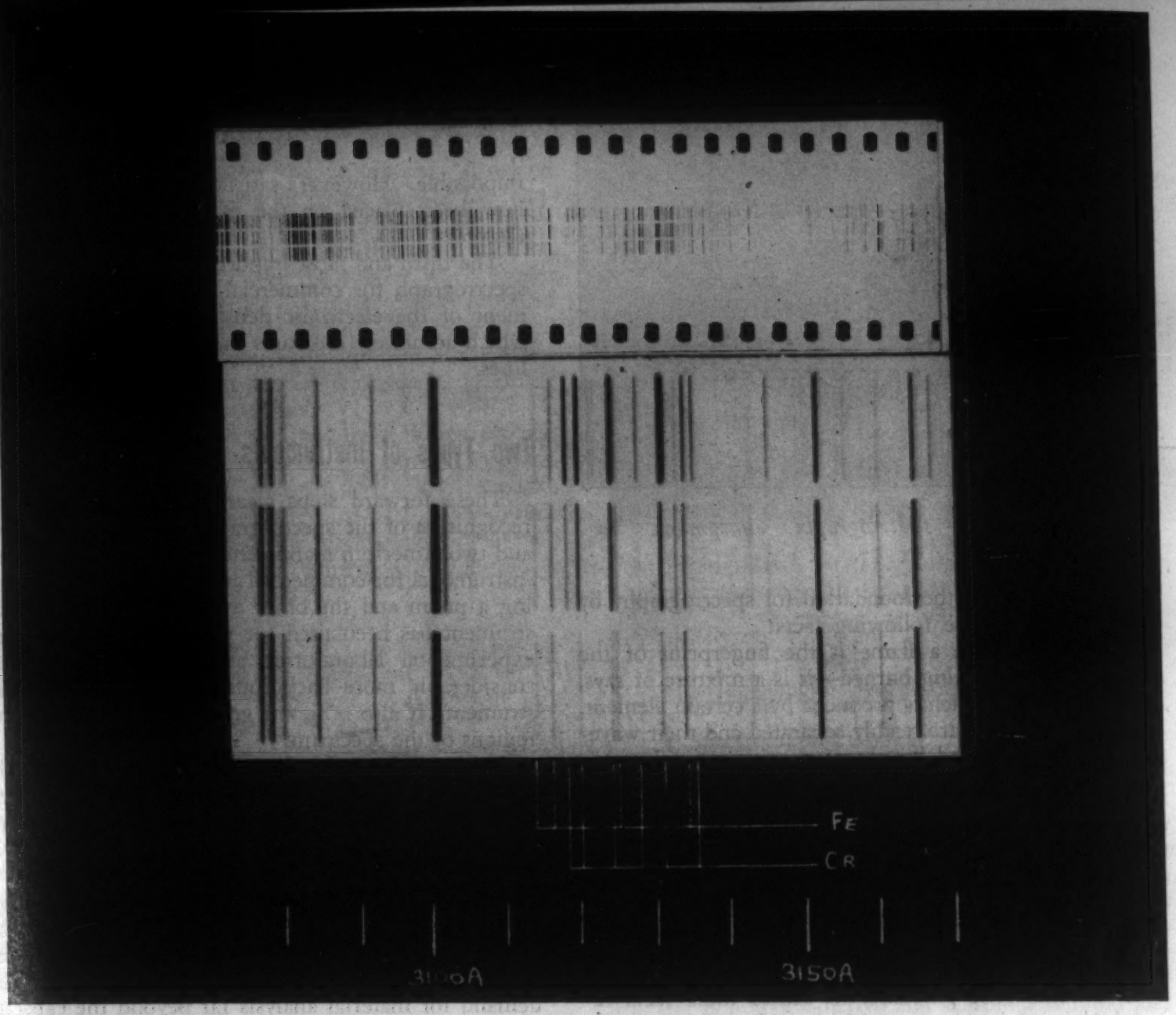


The barge looks a bit humiliated to have to be borne to destination by an unromantic railroad—and particularly in this undignified position. But useful and adventurous days lie ahead!

Here a steel plate to be used in the hull of the landing barge is cut to size in a plate shear.

The radial drill pit is arranged so that any size material can be handled. This shop is among the best equipped in the country for heavy industry.





Portion of a film from the spectrograph (actual size) with spectra of three samples containing respectively 0.18, 0.65 and 2.30% Cr. Enlarged portion shows the effect of the percentage on the blackness of the spectral lines. Note the constancy of the iron lines.

The Spectrograph as an Inspection Tool

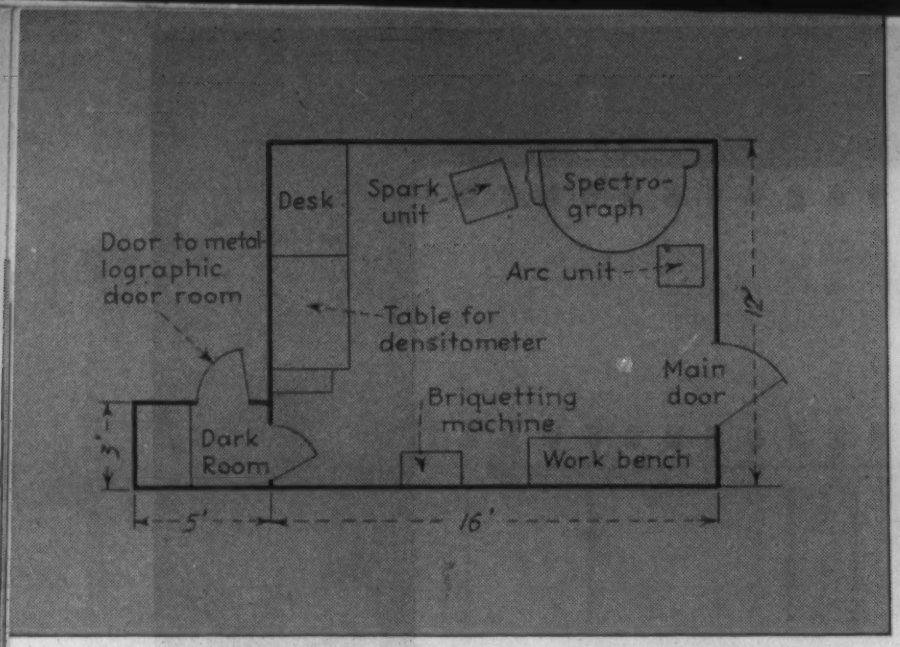
by J. D. GRAHAM and H. F. KINCAID

Asst. Works Metallurgist and Chief Spectrographer respectively, International Harvester Co., Farmwall Works, Rock Island, Ill.

Generally speaking, engineers and production executives are insufficiently informed concerning the practical advantages of the spectrograph for control of raw materials or of foundry production or for identification and sorting applications. This article outlines the principles of spectroscopy, describes the layout and methods used at the authors' plant, and shows how successfully the machine operates as a composition-control tool. —*The Editors*

THE SECRETS of hundreds of materials are being bared by a beam of light scattering from a brilliant rainbow-hued disk and falling on a strip of film. Scientists have broken the bonds that held them to beakers and balances, and smelly, acid-spattered laboratories, by the commercial application of the spectrograph. We will describe one of these applications—but first let us briefly review what this instrument is and how it works.

Light is much more than meets the eye. A sunbeam at noon is apparently yellowish-white, whereas in reality it contains all colors. These colors are due to difference in "wave-length," rays of different wavelength being readily separable—witness the rainbow. Newton, Wollaston, Fraunhofer, and other old friends from your physics book probed into this property



Layout of spectrographic equipment.

of light and laid the foundation for spectrography by demonstrating the following facts:

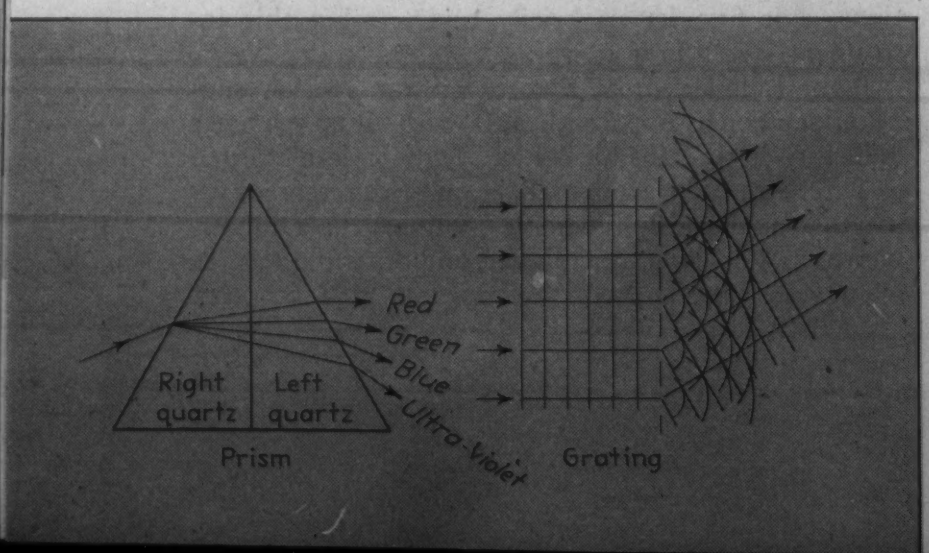
1. Light from a flame is the fingerprint of the material being burned—it is a mixture of rays, each of which is produced by a certain element.
2. These rays are readily separated and their wavelength found by use of a prism or diffraction grating. These separated rays form a pattern called the spectrum of the material.
3. A great many of these rays fall in the ultraviolet region and are invisible, requiring photography for their detection.
4. Once these rays are identified we know the complete make-up of the material being burned.

The patient and often apparently hopeless efforts of a number of physicists to utilize these facts resulted in an instrument which could photograph the spectrum of a material, and could be used for qualitative analysis. The next step, of course, was quantitative analysis, but there existed many serious obstacles to be overcome.

Improvement was needed, not so much in the spectrograph itself, but in the analysis technique, excitation equipment, and instruments for measuring the photograph of the spectrum. As for the first point, development of the internal standard method made possible a practical technique. This method consists in using as a comparative reference a line of the base element (in the case of steel, the base element is iron). Thus minor variations in procedure are eliminated from the final result.

Regarding excitation, until very recently no commercial units were available, and power plants were built on the job, each installation being designed individually. This made similar operating conditions

Dispersion of light by prism and grating. The prism shows simple refraction varying with different wave lengths. The grating shows diffraction due to interference of light waves originating at each grating opening. Diffraction is shown for one wave length only.



impossible. However, satisfactory instruments have now been placed on the market by several manufacturers.

The third and most important step in adapting the spectrograph for commercial work was the development of the electronic densitometer, an instrument which accurately measures the density of the spectral lines.

Two Types of Instruments

These forward steps cleared the way for limited recognition of the spectrograph as a commercial tool, and two American manufacturers began making these instruments for commercial installations, one employing a prism and the other a grating. The prism instrument has been used for years in universities and experimental laboratories, and for this reason had considerably more background than the grating instrument. It also achieved greater dispersion in some regions of the spectrum.

The grating machine, on the other hand, had the advantage of linear dispersion over its entire range, and also used photographic film instead of plates. In addition, the manufacturer of the grating was unique in presenting a complete line of spectrographic equipment, and engineering service. This was the situation at the time our own story begins.

Our plunge into spectrography was occasioned by a large ordnance program, which would increase the demand for material analysis far beyond the capacity of our laboratory. Rather than expand our conventional facilities, we decided to install a spectrograph, in spite of the fact that industrial application of this instrument was quite limited.

First we had to choose equipment, and speed of installation was essential. After carefully weighing all factors the grating machine was chosen as best meeting our requirements since it could be purchased as a unit complete with all auxiliary equipment. A representative of the manufacturer spent several days with us, setting up and aligning the equipment, and giving us the fundamentals on which to establish a routine. Within a month after the equipment was installed, we were running routine analyses of iron and steel—controlling four gray-iron cupolas, checking incoming forgings and bar stock, and making frequent analyses for control of heat-treating processes. A brief description of this equipment and its operation follows:

The Grating Equipment Described

The equipment is installed in a main room 16 by 12 ft. with adjoining dark-room 3 by 5 ft. This space is completely air-conditioned, humidity and temperature control being essential to accurate results. A synchronous motor-driven generator, located outside the rooms, supplies power to the excitation unit, a converter which produces 35,000-volt high frequency current needed for the analytical spark. A multi-reflected beam of light and a photo-tube relay protect the operator from this high tension current.

The spectrograph itself consists of a light-tight wooden case supported on a cast aluminum frame, arranged to hold the slit, the grating, and the camera

in rigid relationship on the theoretical "Rowland Circle." An electrical shutter covers the slit for regulation of exposures. This shutter is controlled by an electronic device which measures the light entering the spectrograph and closes the shutter when proper exposure has been made. A transfer case is provided by means of which a strip of film may be removed from the camera and carried to the dark-room where processing is done in special equipment, including an infra-red drying machine.

The densitometer is an instrument which projects an enlarged image of the developed film on a ground glass screen for visual examination, and also passes a beam of light through the film onto a photo-tube for exact measurement of the blackness of any desired spectral line. A specially constructed slide-rule is used for calculation of results.

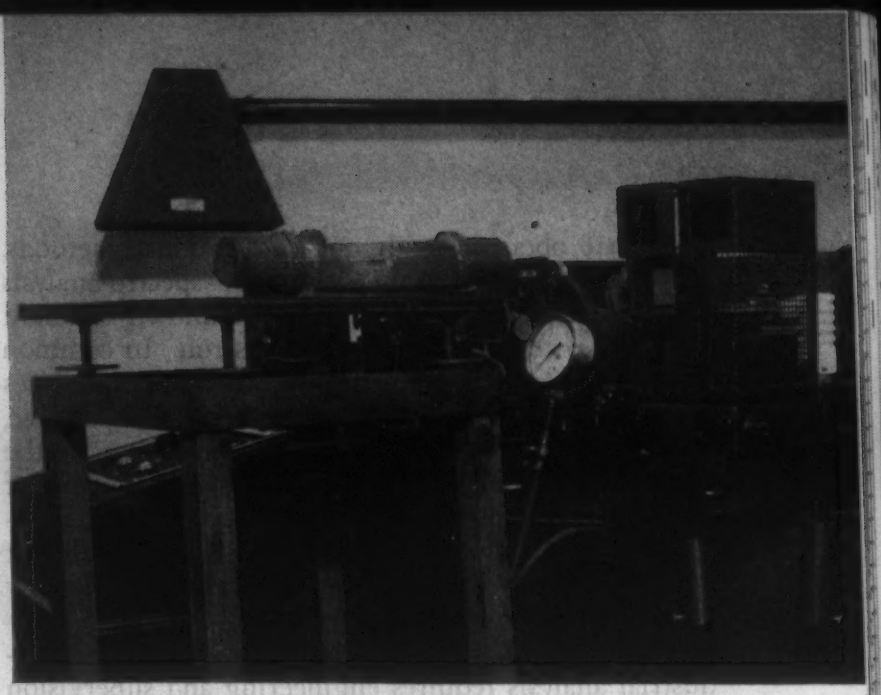
In operation, the sample is placed on a stand in front of the spectrograph slit, and a high voltage spark is produced between this sample and a carbon rod. A small portion of the sample is present as a luminous vapor in the spark, and the light passing through the slit has wave-lengths characteristic of all the elements present in the sample. The light entering the spectrograph case falls on the heart of the equipment—the diffraction grating—a highly polished concave surface on which are ruled 48,000 parallel lines on a two-inch space. This grating reflects and "disperses" the light, separating the different wave-lengths and throwing these sorted rays onto the photographic film.

For each different wave-length of light present, an image of the slit is produced on the film in an exact relative position. After processing, this film shows a row of short parallel lines, each line being an image of the slit as mentioned above, and the entire row being called the spectrogram of the sample. The location of these lines identifies all the materials present in the sample. Their blackness varies with the quantity of the corresponding element present in the spark, and thus is a measure of the percentage in the sample. "Densitometer readings" are taken on the proper lines, and readings are converted to percentages by means of the special slide rule. (Complete details of operating conditions, line pairs, calculating methods, etc., may be found in the *Journal of the Optical Society of America,* February 1944, "An Application of the Spectrograph to the Inspection of Fabricated Iron and Steel", by H. F. Kincaid.)

Table of Reproducibility Tests on a 4340 Steel

Element		Mo %	Ni %	Cr %	Si %	Mn %
Wet Analysis Results		0.28	1.80	0.65	0.27	0.68
Spectrographic Analysis Results	8/17/43	0.28	1.79	0.65	0.27	0.67
		0.30	1.82	0.65	0.29	0.69
	8/18/43	0.29	1.83	0.67	0.29	0.70
		0.28	1.83	0.65	0.29	0.69
	8/19/43	0.28	1.82	0.64	0.27	0.68
		0.28	1.76	0.63	0.27	0.69
		0.28	1.79	0.65	0.26	0.69
		0.28	1.82	0.63	0.26	0.69
	8/20/43	0.28	1.75	0.65	0.26	0.69
		0.28	1.84	0.63	0.26	0.66
	8/21/43	0.27	1.82	0.62	0.27	0.67
		0.27	1.76	0.65	0.27	0.68
	8/23/43	0.28	1.78	0.63	0.26	0.69
		0.29	1.85	0.65	0.27	0.68

The table gives analyses run on different days over a period of a week on the same sample. These analyses were run as a test without making the usual daily corrections to standards.



The forging stand. A heavy forging is held in place over the spectrograph by means of an adjustable supporting stand.

Sampling Technique—The Flat Surface Method

The spectrographic routine is built around the sample. In our opinion there is only one sampling technique which will meet the varied requirements of industrial spectrography as a plant inspection tool, and that is the "flat-surface" method. This method consists in producing the spark between a carbon electrode and a specimen to be analyzed. This spot may be ground or machined on a casting, rough forging, piece of bar stock, etc., or may be a previously machined surface on a finished part. Thus the test is non-destructive and sampling is rapid and convenient.

Using this method, heavy and awkward pieces can be analyzed by supporting them in place on the spectrograph with an auxiliary frame or hoist. We cannot over-emphasize the importance of the fact that this method of analysis is non-destructive. This not only reduces scrap from routine analysis, but also permits us to apply the spectrograph to many special tasks, such as sorting finished parts of varying analysis.

Flat-surface sparking is also responsible in a large degree for the speed of our analysis. A sample brought to the spectrographic laboratory—forging, piece of bar stock, casting, etc.—can be analyzed in 15 min. for any of the following elements which may be present: Manganese, silicon, nickel, chromium, molybdenum, copper, vanadium, and aluminum. Nine samples can be checked in 30 to 45 min., depending on size and shape. Two operators can analyze 100 to 150 samples per 8-hr. day conveniently. Material cost is very low, running about 2¢ per sample for an average volume of work. Total cost will average about 15c per sample, or 3c per determination. Does this beat your wet analysis cost? It does ours! (The above figures, of course, do not include carbon, sulphur, or phosphorus, which cannot be determined spectrographically.)

Accuracy of the Results

But are these speedy results accurate? Quantitative spectro-analysis suffers from a general lack of reputation in this regard. We analyze iron and steel on the spectrograph with accuracy as good as or better

than that obtained with our conventional methods. Repeated tests for accuracy of our spectro-analysis shows a maximum deviation from known standard values of 3 to 5% for any elements run. In common with many of the conventional analysis procedures for steel and iron, spectro-analysis is comparative, and its accuracy can be no better than that of the standards used. Fortunately the National Bureau of Standards has made available a series of spectrographic standards covering a number of different steels. Using these standards, the accuracy is purely a function of reproduceability.

The successful application of this method to industrial analysis requires engineering and supervision by someone thoroughly acquainted with electronics and spectrographic principles. Properly chosen equipment is also essential. If these points are covered, all that is needed is common sense and strict attention to detail. We tackled the spectrograph with no specially trained technicians and made it work, and so can any modern laboratory.

Its scope is definitely not limited to routine analysis of metals. We have already used ours to test questionable paint, to investigate crankcase sludge, and to detect the source of foreign matter in an ammonia system. We are certain that a great many laboratories would find this machine worthwhile.

We don't sell spectrographs. Our point is that the spectrograph has come of age and deserves its place as a reputable laboratory tool.

Stress Corrosion of Cast Irons

A Correction

We regret to state that the following Table was omitted from the article in our May issue, pages 1141 to 1144, entitled "Stress Corrosion of Cast Irons" by R. F. Hehemann, D. A. Shepard and L. Thomassen of the University of Michigan.

—The Editors

Table of Stress Corrosion Behavior of Various Cast Materials

Test No.	Dial reading, ins.	Transverse stress psi.	Tensile strain, ins. per in.	Tensile stress, psi.	Time to failure	Remarks
Austenitic Cast Iron						
1	0.0205	44,850	0.0119	——	1 min.	Pre-stressed cold, heated 5 hrs. with load off, load reapplied.
2	0.0205	42,800	0.0095	23,800	100 min.	Not pre-stressed, started cold.
3	0.0205	41,400	0.0085	——	52 min.	Bar heated in unstressed condition for 5 hrs. before applying stress.
4	0.0175	39,700	0.0068	22,500	3.25 hrs.	Pre-stressed, started cold.
5	0.0155	36,850	0.0043	21,200	12-14 hrs.	Pre-stressed, started cold.
6	0.0109	25,150	0.0021	——	14 hrs.	Bar heated in unstressed condition for 92 hrs. before applying load.
7	0.011	22,900	0.0016	15,600	51.2 hrs.	Pre-stressed, started cold.
8	0.0065	14,650	0.0009	11,800	194.1 hrs.	Pre-stressed, started cold.
9	0.0040	9,280	0.0006	9,000	408 hrs.	Started cold without pre-stress, bar removed unbroken after relaxation to 7890 psi.
Gray Cast Iron						
10	0.0182	42,200	0.0041	——	4.3 hrs.	Pre-stressed, started cold, liquid dark with heavy black precipitate.
11	0.0115	22,750	0.0016	——	326 hrs.	Pre-stressed, started cold, liquid very black, removed unbroken after relaxation to 20,700 psi.
Malleable Iron						
12	0.0182	40,600	0.0014	——	330.5	Started cold without pre-stress, liquid very dark, removed unbroken with no relaxation of stress.

A MICROSTRUCTURAL GUIDE TO THE

Heat Treatment of a Plain Carbon Steel

by R. J. RAUDEBAUGH and W. E. FONTAINE

Instructors of Metallurgical and of General Engineering, respectively, Purdue University, Lafayette, Ind.

The service properties of a steel part depend largely on its microstructure, which is in turn a function of the heat treatment it receives. The charts and photomicrographs that are the basis of this article depict the various heat treatments and cycles that might be applied to a plain carbon (0.40% C) steel and the respective microstructures that these produce in this steel. The article may thus be used not only as a means of metallographically controlling heat treatment, but also for selecting the best heat-treating practice to produce a specific, desired microstructure. —*The Editors*

IT IS A WELL KNOWN FACT that microstructural characteristics of steels and hence their physical properties are dependent to a large extent on heat treatment. Such variables as cooling rate from the austenitic condition, temperature to which quenched steels are re-heated and time that they are held at temperature are of the utmost importance and must be controlled in the interest of obtaining specified properties.

To illustrate the effect of these variables in a concise manner, the charts reproduced herewith have been prepared from data obtained on a 0.4% C steel.

One inch pieces cut from 5/8-in. hexagonal bar stock were used as samples. All heating operations were carried out with samples packed in cast iron millings to minimize decarburization. Microstructures are representative of conditions in transverse sections near one end of the sample. Unless otherwise noted, all specimens were etched in 3% nital and photographed at 1000X.

Chart 1 illustrates the effect of cooling rate from the austenitic region on the steel under consideration. The hardness of the brine quenched specimen (58.-5Rc) may be considered as maximum for a 0.4% C steel. The structure is typical of low carbon martensite. Quenching in the lead-tin alloy bath at 550 F apparently induced a more rapid initial rate of cooling than quenching in oil at room temperature as shown by the smaller amount of rejected ferrite in its microstructure. Arresting the quench at 550 F, however, undoubtedly produced an excellent combination of hardness and impact strength. Commercial austempering treatments follow such cycles.

Air cooling from the autenitic region (normalizing) results in smaller, more uniform grains (see figures taken at 200X) and finer lamellar pearlite than furnace cooling.

The austenitic grain size of two specimens of the same steel may vary widely without being evident in their equilibrium or quenched structures at room temperature. This is illustrated in Chart 2. Figs. 2-3 and 2-4 (200X) are representative of the variation in austenitic grain size produced by soaking two identical specimens for 1 hr. at 1500 and 1800 F respectively. Each sample was cooled slowly from its soaking temperature to just below the Ar_3, thus permitting a ferrite network to form at the boundaries of the austenitic grains. Subsequent oil quenching caused the remaining austenitic core of each grain to transform to martensite.

Figs. 2-1 and 2-2 are representative of quenched structures of the fine and coarse grained austenitic specimens and it is clearly evident that the difference in austenitic grain size is not apparent in these structures. It is likewise quite unlikely that variations in austenitic grain size of two specimens could be detected from observation of their equilibrium structures at room temperature (compare Figs. 2-6 and 2-7).

Fig. 2-5 is representative of the structure formed by cooling a specimen slowly from 1500 F to considerably below the Ar_3 but above the Ar_1 and then quenching it in water. By comparison with Fig. 2-3 (specimen slowly cooled from 1500 F to just below Ar_3 and then oil quenched) it may be seen to contain more rejected ferrite and a somewhat lighter etching martensitic structure.

The fact that similar structures and hardness values were obtained after quenching of the fine and coarse grained austenitic specimens does not mean that control of austenitic grain size is unimportant. Uniformity of hardness in quenched sections (hardenability) and distortion may be markedly affected by

the austenitic grain size at the time of quench. Hence the emphasis on grain size controlled steels.

Chart 3 bears testimony to the well known fact that the hardness and structure of quenched and tempered steels may be controlled by the selection of the tempering temperature. Considerable evidence of the quenched structure is still apparent in Fig. 3-1 and very little softening has accompanied this low temperature treatment. Increasing the tempering temperature results in the establishment of a more uniform sorbitic structure and progressive softening.

The effect of tempering time at two temperature levels is portrayed in Chart 4. An increase in time of tempering within limits may be expected to produce lower hardness and coarser sorbitic structure and its effect is more pronounced at higher tempering temperatures. A difference in hardness of only 5 points Rc was noted after tempering 1 and 16 hr. at 600 F. whereas at 1300 F. the hardness decreased from 19 Rc to 86 in the same time interval. Fig. 4-3 which is representative of the structure at the end of a 16-hr. temper at 1300 F. illustrates a completely spheroidized condition.

A comparison of Chart 5 with the results at 1300 F. in Chart 4 indicates the impracticability of attempting to spheroidize a pearlitic structure at subcritical temperatures.

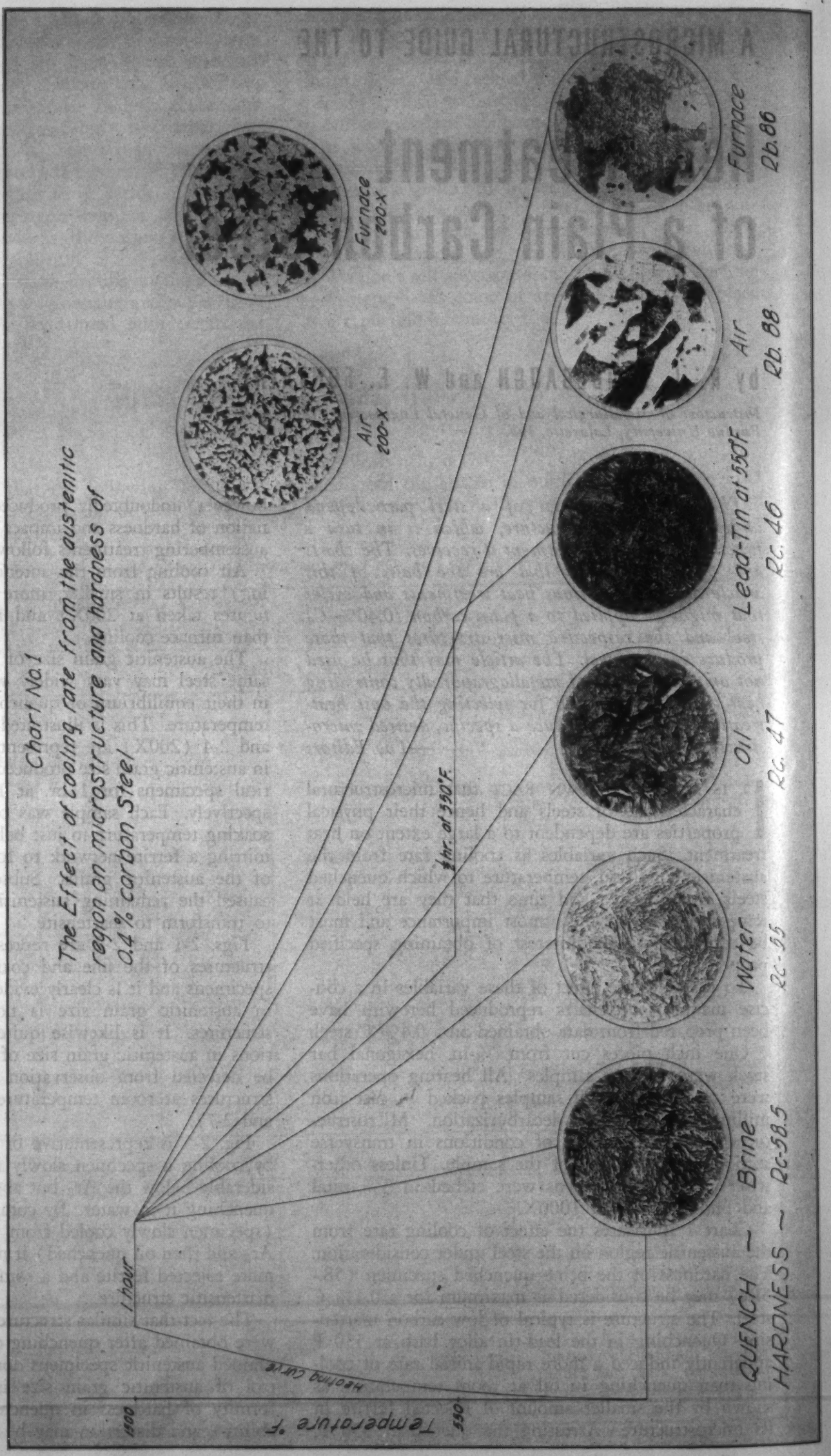


Chart No. 2

Structures and hardness values associated with various cooling cycles from 1500°F to 1800°F. (.04% C steel.)

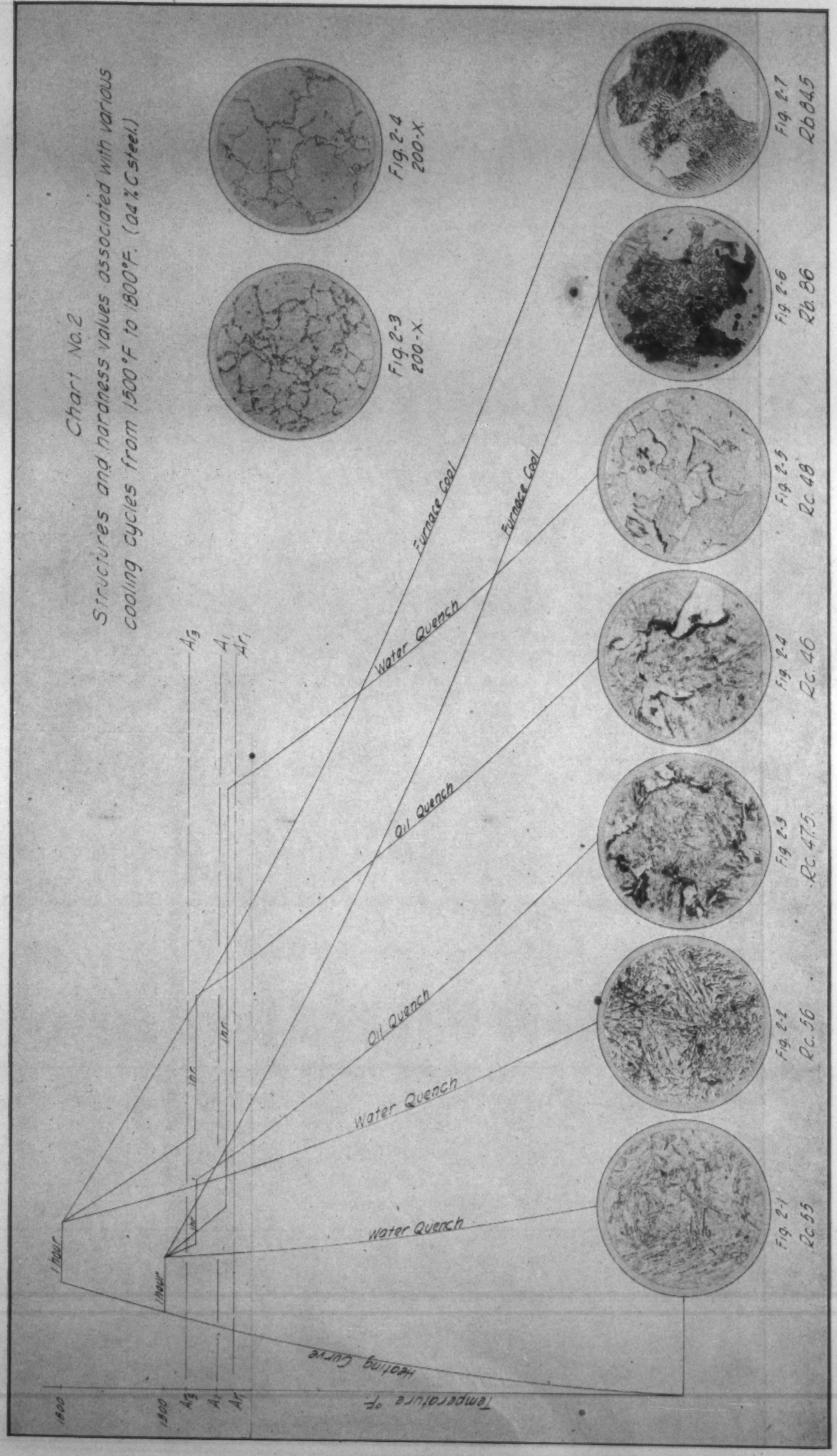


Chart No. 3

The Effect of Soaking for 1 hour at various sub-critical temperatures on the structure and hardness of water quenched 0.4 C steel.

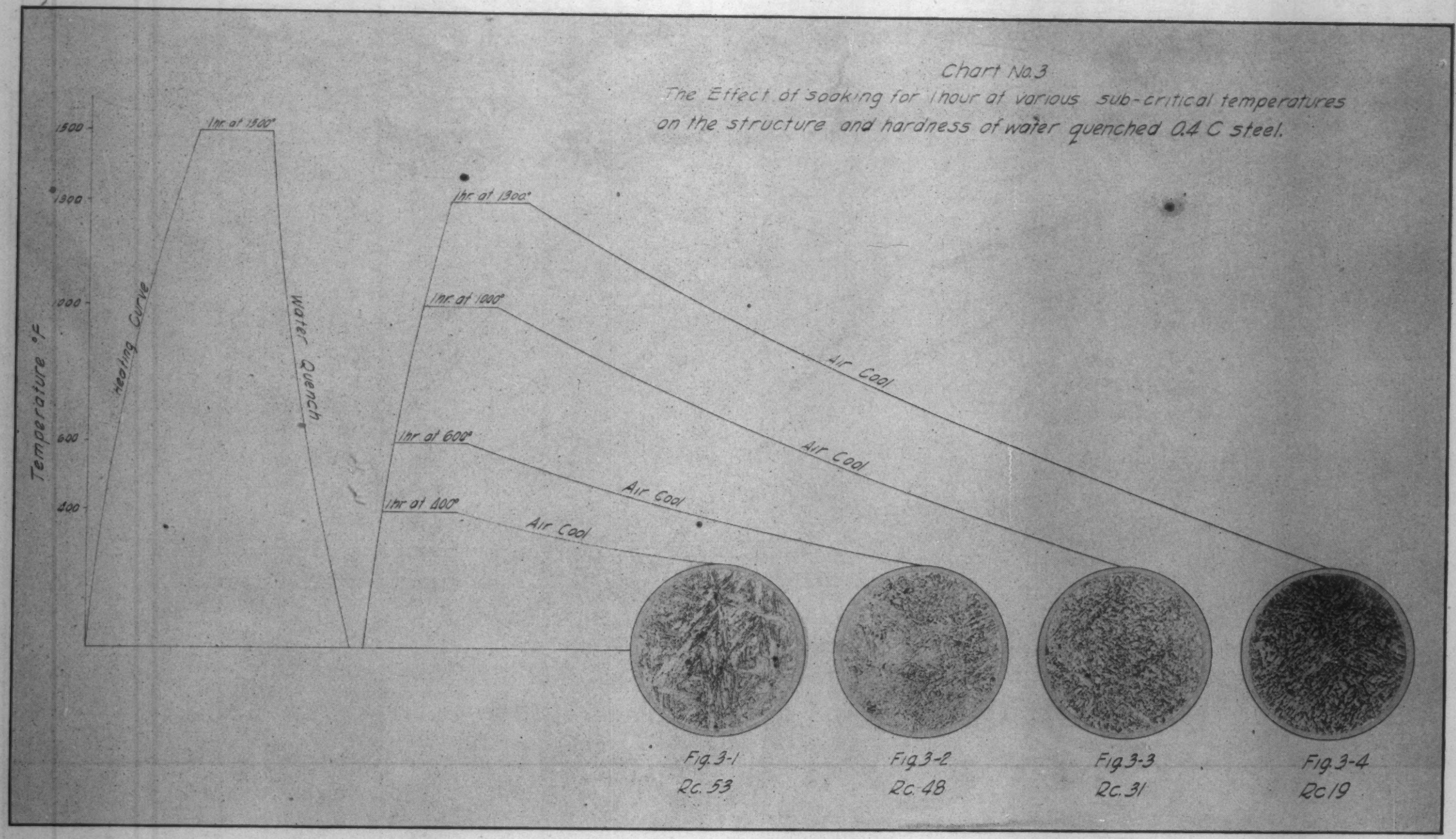


Fig. 3-1 Rc. 53

Fig. 3-2 Rc. 48

Fig. 3-3 Rc. 31

Fig. 3-4 Rc 19

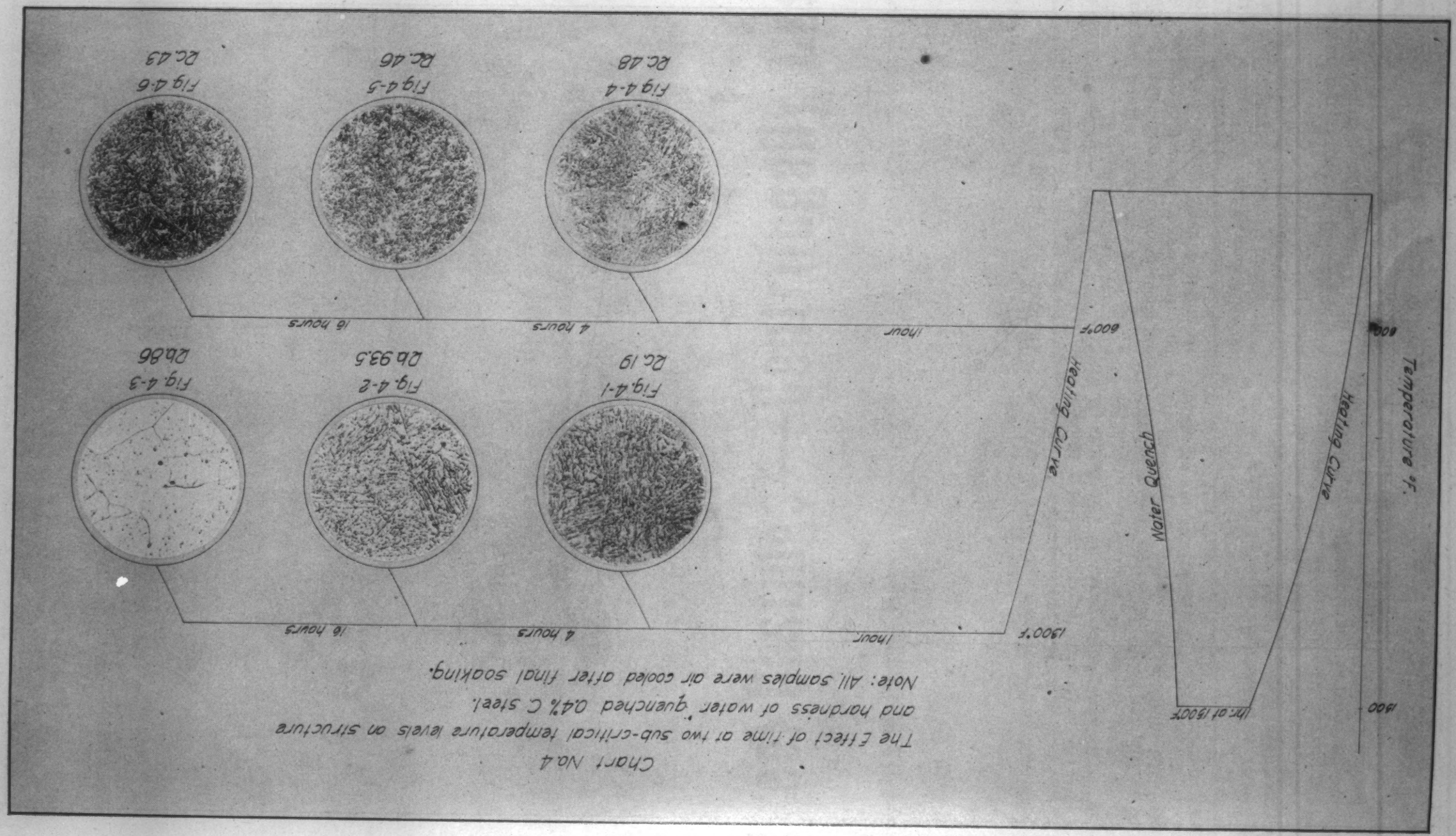


Chart No. 4

The Effect of time at two sub-critical temperature levels on structure and hardness of water quenched 0.4% C steel.

Note: All samples were air cooled after final soaking.

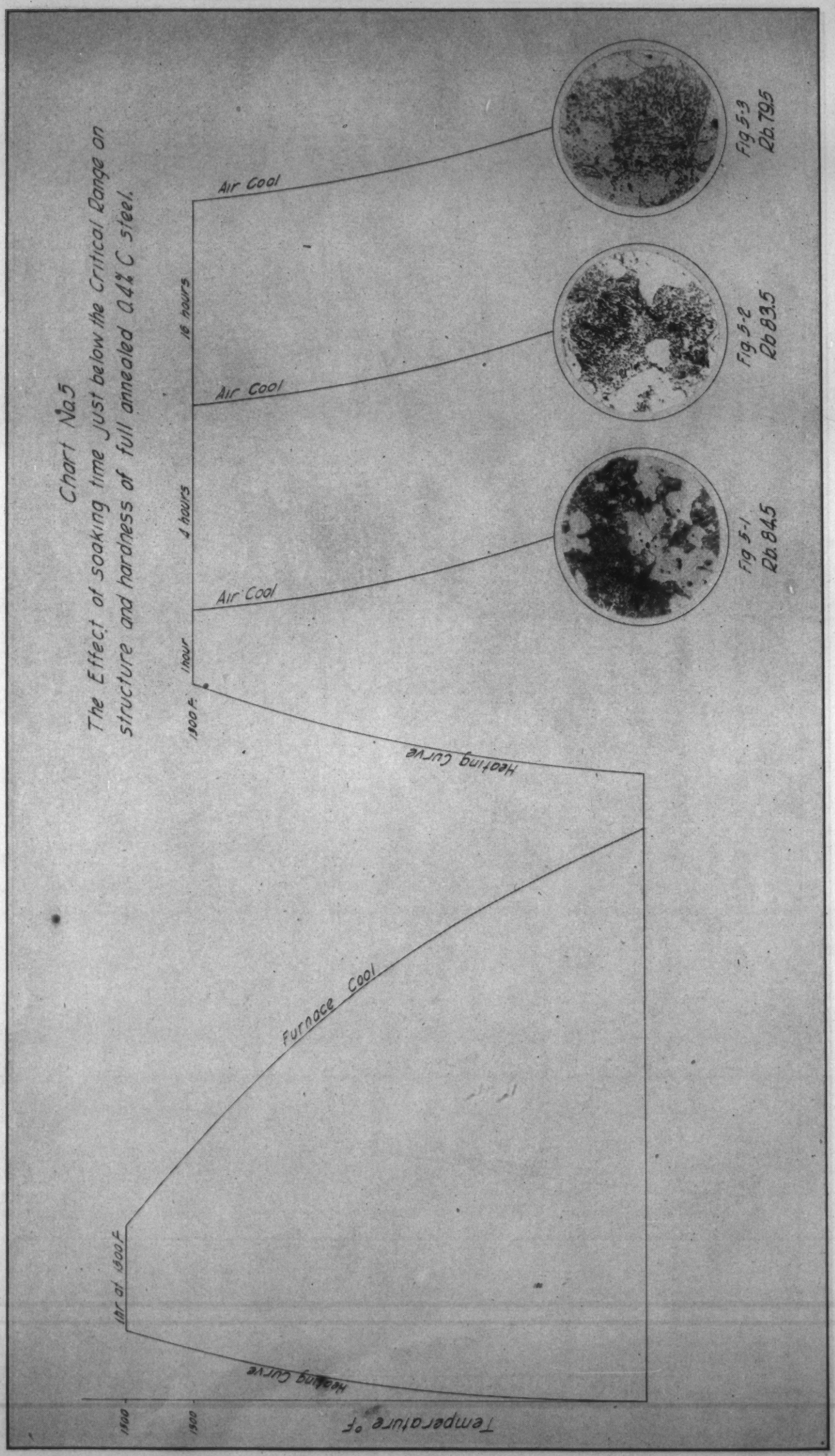


Chart No 5
The Effect of soaking time just below the Critical Range on structure and hardness of full annealed 0.4% C steel.
Heating Curve
1800 F.
1 hour
Air Cool
1 hours
Air Cool
16 hours
Air Cool
Fig 5-1
Rb 84.5
Fig 5-2
Rb 83.5
Fig 5-3
Rb 79.5
Heating Curve
1 hr at 1800 F
Furnace Cool
1600
1300
Temperature °F

Battery of 12 horizontal axis casting machines for producing "true-centrifugal" steel tubes.

Steel Castings—Centrifugally Cast

by **JAMES W. MOORE** *American Cast Iron Pipe Co., Birmingham, Ala.*

Steel castings, centrifugally cast, have emerged in the war period as a metal-form capable of providing real competition for steel forgings and other wrought forms for certain types of products. This article defines the types of centrifugal castings, outlines the fields of use, (especially in competition with other forms) and illustrates the shapes and products for which steel castings, centrifugally cast, are especially useful. —*The Editors*

SEVERAL ARTICLES have appeared recently on the centrifugal casting of steel. This article will deal principally with the castings, and secondarily with the process. The description of the centrifugal processes presented here is necessarily a repetition of data contained in articles that have appeared recently. Credit to the authors of these previous articles is gratefully acknowledged.

Three Methods Defined

The broad term "centrifugally cast" embraces three methods of casting: "True centrifugal," "semi-centrifugal" and "centrifuging."

The "true centrifugal" method is spinning the casting about its own axis and using centrifugal force to hold the metal on the wall of the mold, thus forming the inside without the use of a center core. When a mold is spun about a horizontal axis, the interior cavity formed by the molten metal is a true cylinder, regardless of the shape of the outside of the casting. The inside diameter is determined by the volume of metal poured.

It is practical to cast irregular outside shapes such as ribs, bosses, or other protrusions. A flange or projection may be cast on one end but not on both ends of a long tube. External projections on both ends tend to prevent contraction that accompanies solidifi-

Battery of 72 horizontal axis casting machines to produce "true-centrifugal" parts.

cation, as shown by one of the drawings and illustrations.

"Semi-centrifugal" casting is spinning a casting about its own axis—usually about the vertical axis. If the casting has a center cavity, this cavity is usually formed with a center core, and the casting is fed by a center gate passing down around this core. A drawing illustrates this method. In some cases the center is cast solid and the center cavity, if any, is machined out, or cut out with an oxy-acetylene torch.

Metal molds, sand molds, or a combination of metal and sand molds may be used. Stack molding, where a number of castings are made in one pour, is well adapted to this method. This is shown by one of the illustrations.

In "centrifuging" the molds forming the useful castings are positioned near the periphery of the revolving table. The metal is poured into a gate located on the axis of rotation and is fed into the molds by radial sprues. Centrifugal force is used merely to provide liquid pressure. Usually, two or more castings are made in each mold. A typical example of centrifuging is shown by an illustration. The center gate with radial sprues feeds the castings. This method is well adapted to stack molding of odd-shaped castings.

Centrifugal vs. Static Method

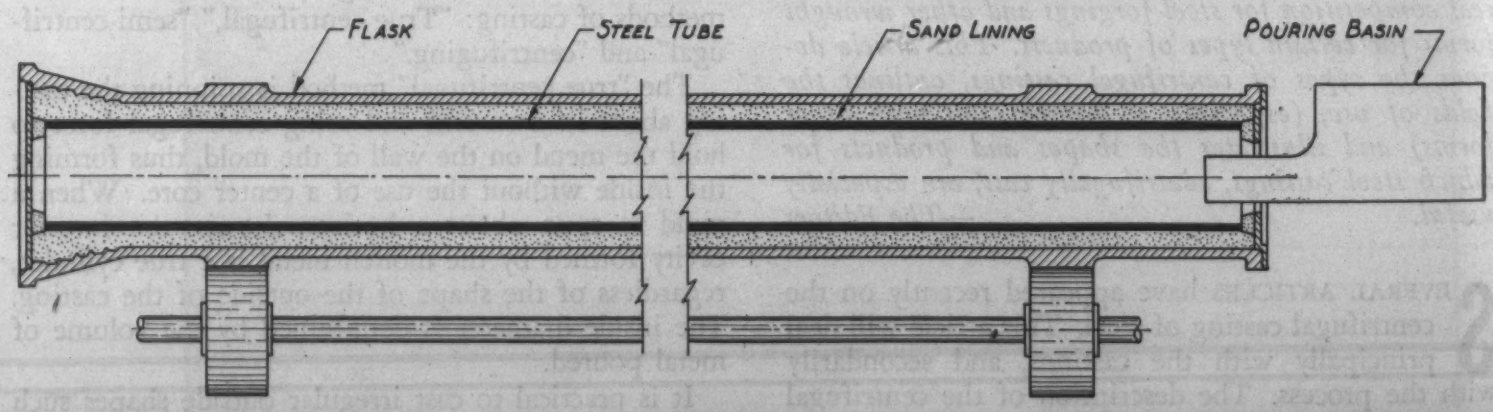
In the broad use of the term, a great variety of shapes may be centrifugally cast. The choice of whether to produce a steel casting by one of the three methods, classified broadly as "centrifugal" or the conventional "static" method, will be dictated by the available equipment, size and shape of the casting, and the number of castings to be produced for any particular part. It may be possible to produce satisfactory castings by all of the above mentioned methods, and several different ways by each method. The final choice may indeed be made for one method after satisfactory castings have been produced by one or more different methods. Quality and economics are the chief deciding factors.

It is possible to produce good, sound castings by either the centrifugal or static methods. By the same token, castings that are not good may result from either method. Centrifugally casting the steel is not a cure-all. Just spinning the mold, in itself, is not enough. The chemistry of the steel, melting and other metallurgical factors, as well as proper feeding of the metal, rate of pouring, speed of spinning, controlled directional solidification, and other foundry techniques, all dictated by experience, are essential.

While the choice of method for producing some shapes is debatable, there are certain types of parts that are "naturals" for centrifugal casting. Radial engine cylinder barrels, cylinder sleeves, bearing backs, and other short cylindrical parts having straight cylindrical insides, and required in large volume, lend themselves especially to centrifugal casting in metal molds spun on the horizontal axis.

Long tubes, such as required for hydraulic cylinders and plungers, hollow shafting, retorts, and refinery still tubes are peculiarly adaptable for economic production by the centrifugal casting method in sand-lined refractory molds spun on the horizontal axis. Many parts which are, in effect, short cylinders, such as, bogie wheel hubs, pump liners, motor and generator frames, ring gears, hoist drums, seat rings, bushings, etc., may be produced from centrifugally cast steel tubes.

Parts which are symmetrical, having a hollow center, such as flywheels, gears, track wheels, etc., may be readily classified as suitable for semi-centrifugal casting. Stack molding will offer further possibilities for economic semi-centrifugal production. Odd shapes, such as levers, cams, brackets, and other solid parts commonly produced from drop forgings, may be economically produced from "centrifuged" castings, as illustrated by the "Christmas-tree" shown by one of the illustrations.



"True Centrifugal" casting—cross section of a mold for making a steel tube as mounted on rollers of the casting machine.

It is apparent that steel castings produced by the true centrifugal method in metal molds and the semi-centrifugal method in sand-lined molds are especially adaptable for the production of parts which may also be produced from steel forgings, and hot rolled shapes. Centrifuging is adaptable for the production of castings for parts which may also be produced from steel drop forgings and static castings. Centrifugally cast steel tubes may be used to produce parts heretofore produced from steel forgings and hot rolled shapes, as well as from seamless and drawn tubing.

Competition with Forgings and Other Products

Steel castings, centrifugally cast are, and will be, more in competition with forgings and other wrought steel products than with static steel castings. As compared with static casting, the economic field for centrifugal castings is somewhat limited. The centrifugal process is not especially adaptable to economic production of intricate shapes requiring delicate or complicated cores. It is improbable that the centrifugal method will be found to be economical for the general run of so-called jobbing work where only a few castings are ordered at a time, nor for very large castings. The chief field for steel castings, centrifugally cast is for relatively large volume requirements, and chiefly in competition with forgings and wrought steel products.

Compared with static castings, centrifugal castings require more science and less art in production. Steel castings, centrifugally cast, should be consistently cleaner and sounder, less likely to have concealed defects, and consequently less rejections developed through process machining, and should give a higher production yield.

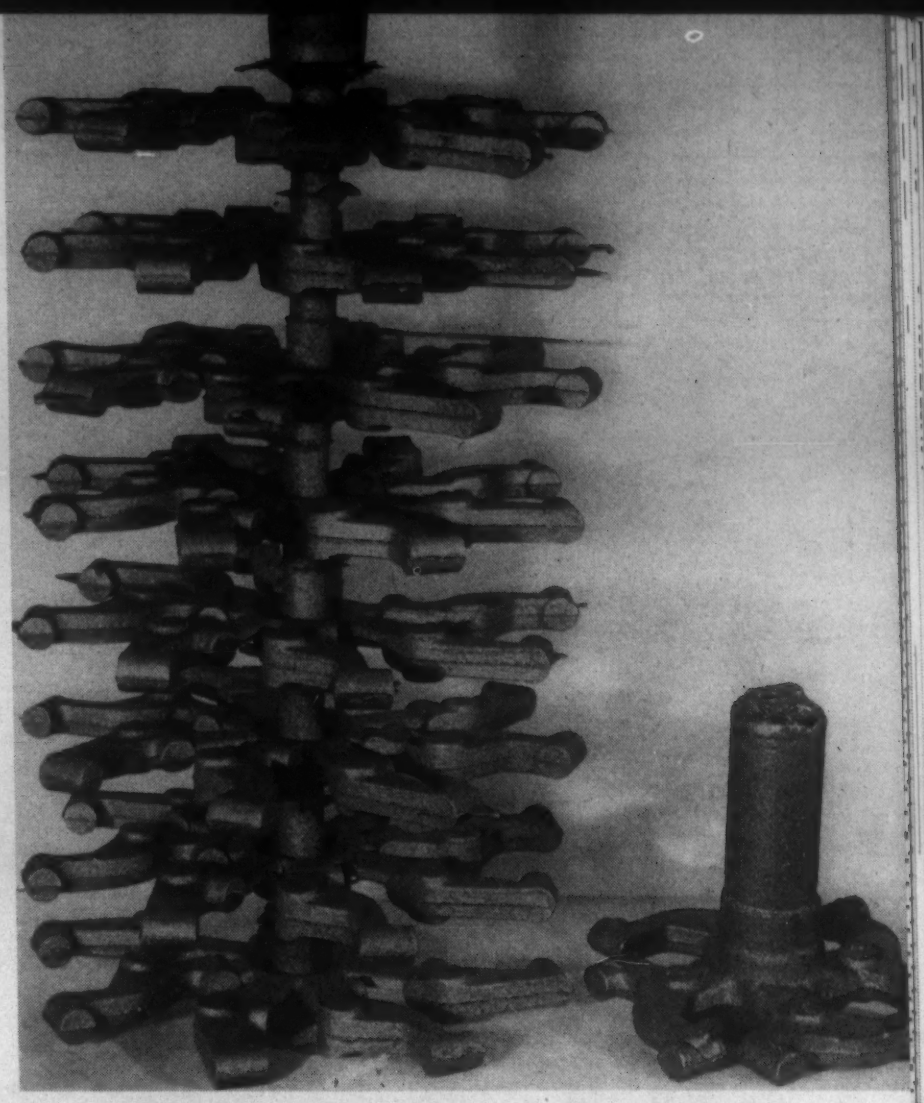
Compared with steel forgings, steel castings, centrifugally cast, should have the following advantages: They may be furnished nearer to finished dimensions with consequent reduction in process machining cost; lower capital investment for production equipment; and freedom of marked directional properties.

S.A.E. 4140 steel castings, centrifugally cast, are being used in the place of forgings for engine fly wheels, gear blanks, radial cylinder barrels, bomber landing gear parts, etc. These castings have ultimate tensile strength in excess of 175,000 p.s.i. with yield strength in excess of 165,000 p.s.i.

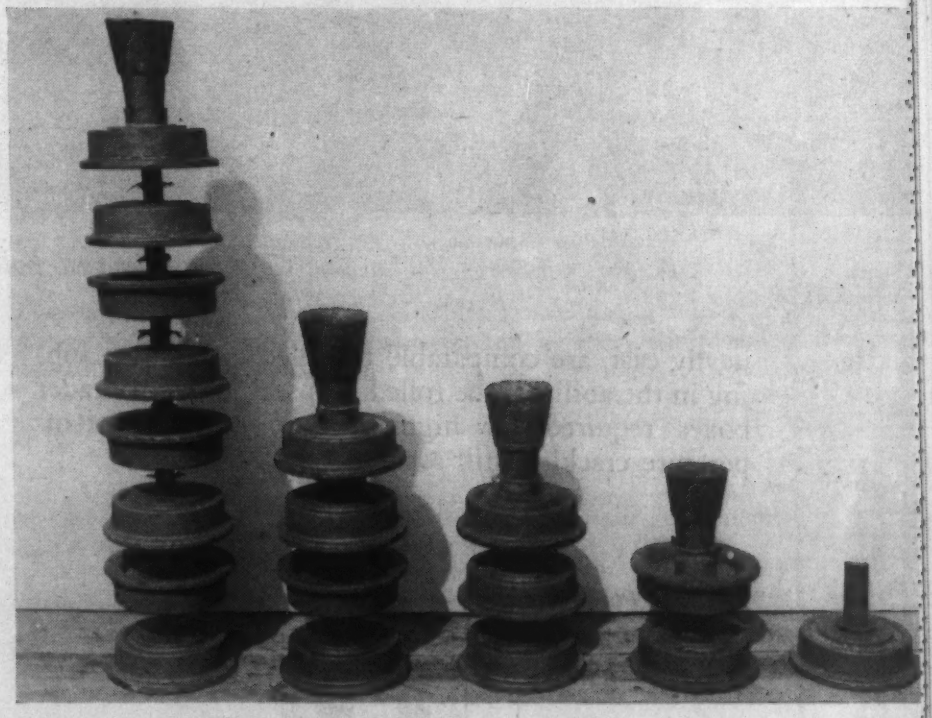
Comparison of Physical Properties

While the comparison of physical properties is yet to be explored for all types of steel, considerable data have been accumulated. Tests have shown S.A.E. 4140 steel castings, centrifugally cast, to be comparable with 4140 steel forgings as to ultimate tensile strength, yield strength, elongation, reduction of area, polished and notched bar fatigue strength, and impact resistance. Some tests have shown higher notched bar fatigue strength for the castings than for forgings of comparable chemical analysis.

Tests have shown the creep characteristics of cast steel to compare favorably with rolled and drawn steel in four low and intermediate "chrome-moly" steels. Tests have also shown that steel tubes, centrif-

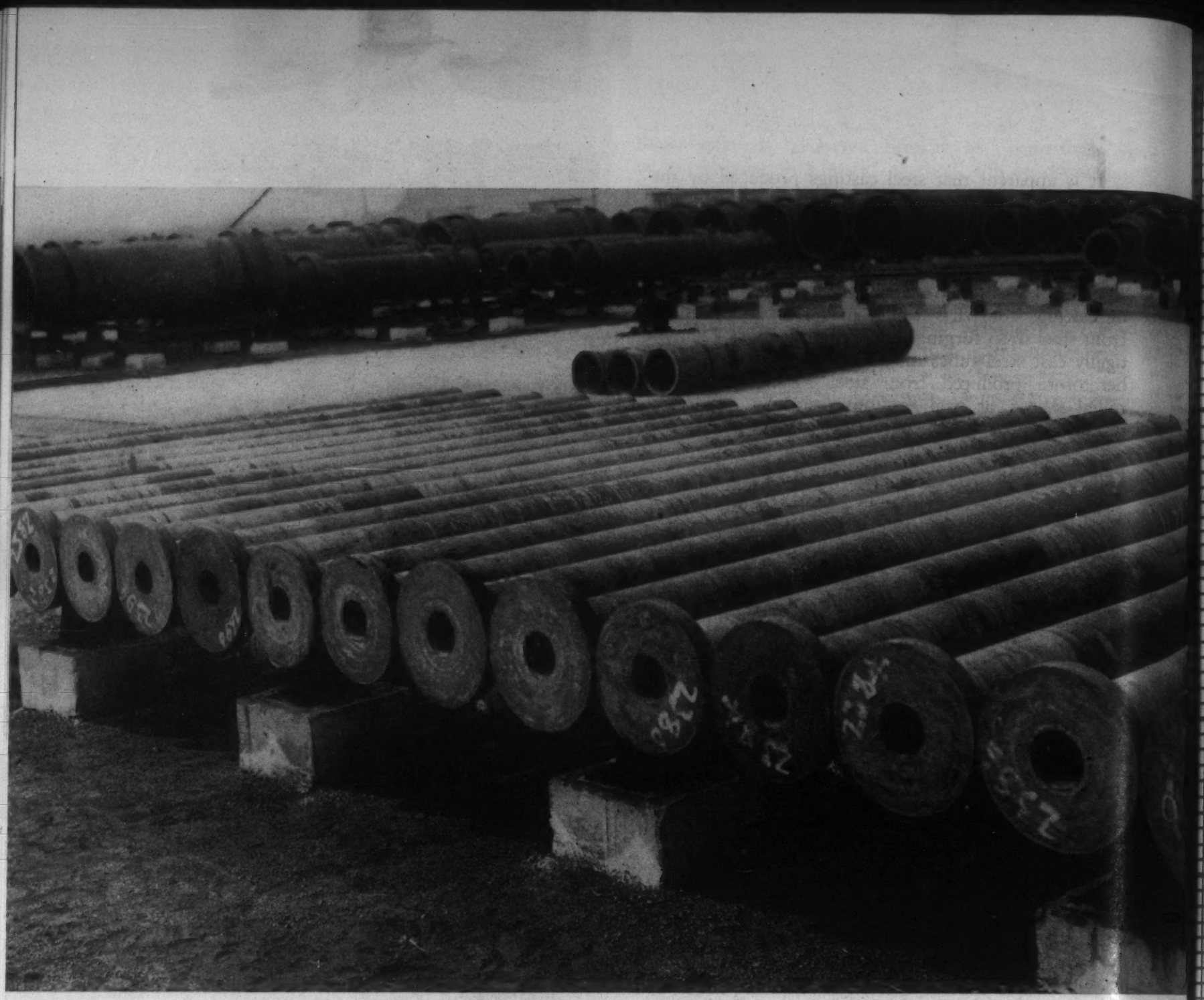


A "Christmas tree" as delivered to the cleaning sheds. An illustration of "centrifuging" lever castings in stack molds.



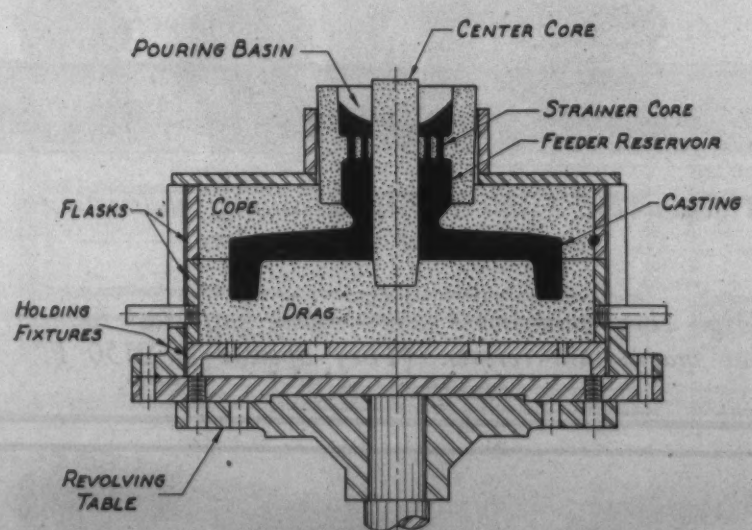
Track wheels—semi-centrifugal castings illustrating the benefits of stack molding.

High chromium-nickel centrifugally cast steel tubes for magnesium retorts. (They operate at 2150 F. temperature.)



Centrifugally cast hollow shafting for ships.

ugally cast, are comparable to rolled and drawn tubing in the ability to be rolled into seal joints in header boxes required for high pressure and high temperature cracking still service.



"Semi-Centrifugal" casting of flywheels and gear blanks.

For some services cold working and hot working of steel as represented in forgings and other wrought products may have value in improving certain of its physical properties in the direction in which it is "worked." However, such "working" produces directional properties which appreciably reduce the ductility as well as other salient properties when measured transversely to the direction of working. Steel castings, centrifugally cast, are free from directional properties. The strength and ductility are substantially the same in all directions.

It is apparent that the physical properties of centrifugal steel castings compare favorably with the properties of forgings and other wrought steel products of similar analysis—for some applications, perhaps not quite so good; for other services, somewhat better. There is a field for both. In many cases the final choice will perhaps be based on economics, or in the vernacular—"What's the price?"

Centrifugal casting of steel is a relatively recent development that has made rapid strides due considerably to the war program. The field of application for steel castings, centrifugally cast, seems destined to enlarge, not only from now until "V" Day, but well into the post-war era.

NUMBER 54
August, 1944

Electrical Contact Materials

Metals for electrical contacts must carry the maximum current which may be applied. They must, for most installations, be hard enough to withstand the wear of repeated contacts; should dissipate the heat generated by the current passed, and by any momentary arcing when contact is made or broken, and should resist welding or sticking. For some applications resistance to corrosion is of great importance.

Metals selected for this exacting service naturally include some that are uncommon in everyday applications. The materials may be divided into three groups; pure metals, alloys, and duplex or compound materials made by powder metallurgy. They may be classified according to properties as:

Hard metals, as molybdenum, tungsten, and certain metal compacts—characterized by high melting point or hardness. The metal compacts are usually tungsten or molybdenum with silver or copper added to increase conductivity. Used where currents are small and mechanical wear is high.

High conductivity metals, as copper, silver, and many alloys—characterized by very low electrical resistance, and low contact resistance. The alloys are usually of copper or silver, with each other, or with cadmium, nickel, palladium, etc. Used where high currents must be carried and mechanical wear is not great.

Non-corroding metals, such as platinum, gold, palladium, mercury, and alloys—characterized by great resistance to corrosion. The alloys are usually platinum or palladium alloyed with other platinum metals, as iridium or ruthenium, or with silver; or gold alloyed with silver, etc., to increase hardness. Used where currents are low and pressure light, but good sensitivity is required.

Types	Metal	Distinctive Properties	Typical Uses
Hard Metals	Tungsten	Extremely hard, non-welding, good conductivity. Melting point, 6098 F.; resistivity, 5-9 microhm/cm.	Automobile ignition distributors and other automotive equipment, telephone equipment, microphone switches, frequency generators
	Molybdenum	Can be prepared in spring tempers; lower resistance to wear and to welding than tungsten, and lower contact resistance. M.P., 4748 F.; resistivity, 4.8 microhm/cm.	As electrodes in mercury switches; for semi-continuous operations, as electric signs, vibrators, telegraph relays
	Duplex Tungsten-Silver, Molybdenum-Silver, Tungsten-Copper Materials	Silver-containing compacts in general used for interrupting circuits in air, copper-bearing materials under oil	Primarily for heavy duty, as industrial motor starting switches, circuit breakers, aircraft equipment
High Conductivity Metals	Copper	High conductivity, cheapness. M.P., 1981 F.; resistivity, 1.72-1.77 microhm/cm.	Where heavy currents must be carried—many types of switches, motor commutators, generator collecting rings
	Silver	Highest conductivity of the metals, low contact resistance; used where sensitivity is important. M.P., 1761 F.; resistivity, 1.62 microhm/cm.	Thermostats, slot machines, light duty relays
	Sterling Silver (Ag 92.5, Cu 7.5%)	Harder than pure silver, more resistant to sulphur corrosion, slightly higher contact resistance. Resistivity, 1.8 microhm/cm.	Automotive and aviation equipment, light relays
	Coin Silver (Ag 90, Cu 10%)	Resistivity, 1.87 microhm/cm.	
	Silver-Copper Alloys	Hardness increased, conductivity lowered with increasing copper content	Automotive and aviation equipment, light duty relays
	Silver - Palladium Alloys	High resistance to corrosion, low contact resistance	Dial telephone, other telephone and telegraph relays
	Silver-Gold, Silver-Platinum Alloys	High resistance to corrosion	For equipment subject to corrosive conditions
	Silver-Cadmium Alloys	High resistance to sticking or welding; good wear resistance	Motor starters, circuit breakers, aviation relays
Non-corroding Metals	Platinum	High resistance to corrosion; high melting point. M.P., 3224 F.; resistivity, 9.83 microhm/cm.	One of the first used contact metals; laboratory apparatus, recording meters
	Platinum-Iridium, Platinum - Ruthenium Alloys	Harder than pure platinum	Voltage regulators, thermostats
	Palladium	Low contact resistance usually alloyed with silver, platinum, etc., for greater hardness. M.P., 2831 F.; resistivity, 10.8 microhm/cm.	In light duty relays
	Gold-Silver Alloys	High corrosion resistance, cheaper than platinum	Telephone or other light relays
	Mercury	Liquidity utilized in certain types of apparatus. M.P., -38 F.; resistivity, 95 microhm/cm.	Laboratory apparatus, light duty relays

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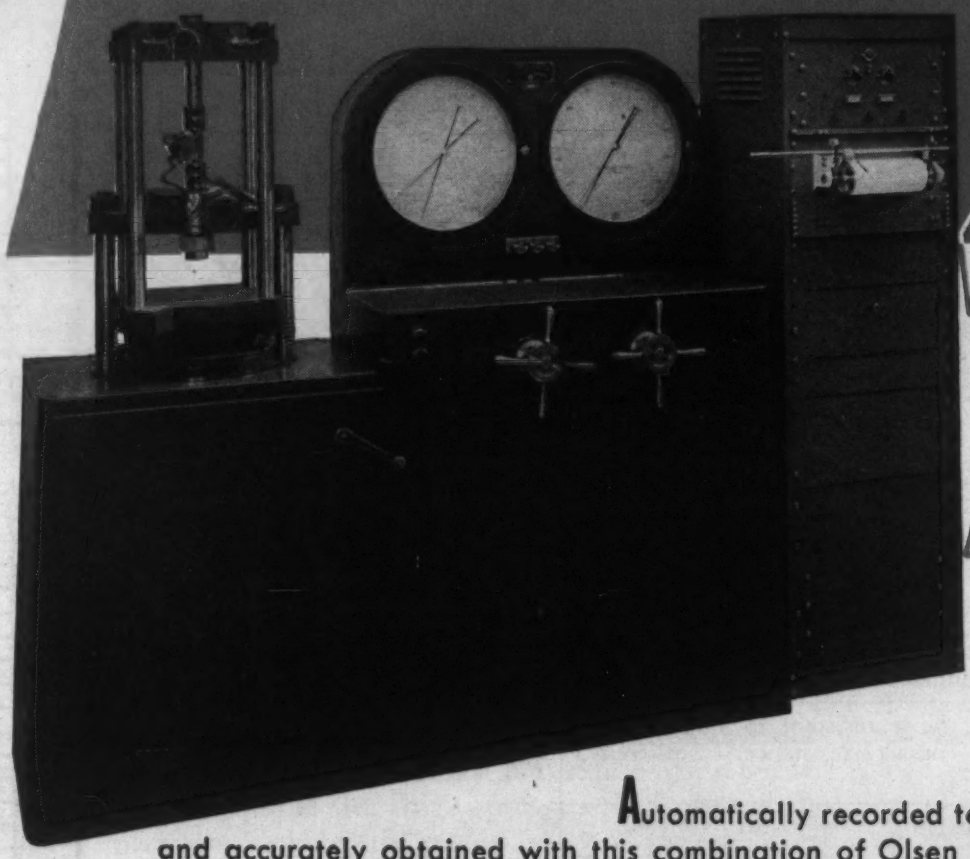

MATERIAL CHARACTERISTICS IN CHART FORM

1. MAXIMUM STRENGTH
2. PROOF STRENGTH
3. YIELD STRENGTH.
4. TYPE OF YIELD

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METALS and ALLOYS
Engineering File Facts

NUMBER 55
August, 1944

Pickling Processes for Iron and Steel

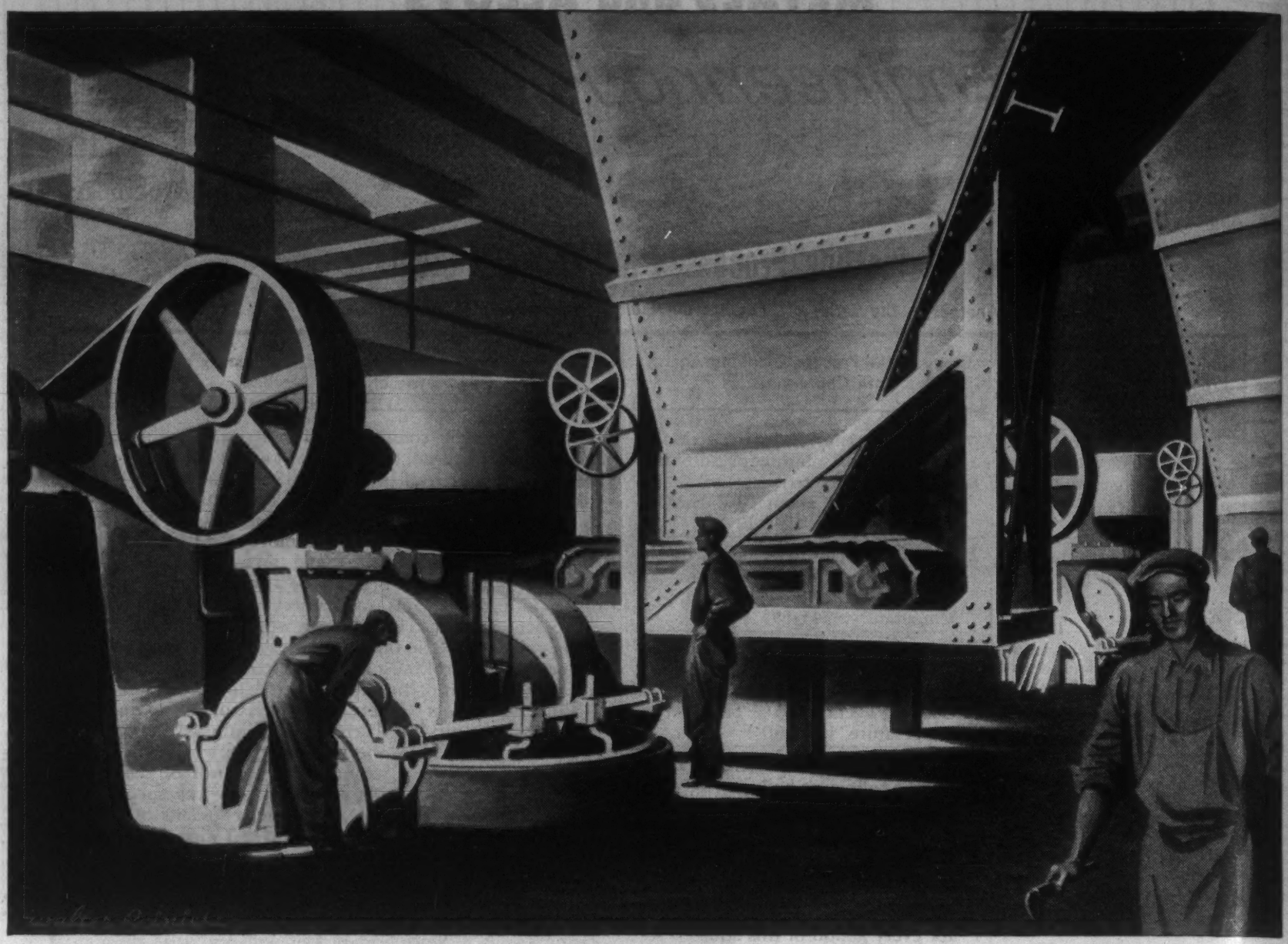
Another in the Series of "Engineering File Facts" on Metal Cleaning Processes

Name of Process	Type of Work Handled	Scope of the Process, Cleaning Agent, Bath Characteristics	Economic Considerations; Equipment and Type of Labor Needed
Pickling	Low carbon, hot rolled steel sheet and strip	Mill scale is removed by the action of a warm, dilute solution of sulphuric acid. Bath characteristics: cleaning agent, about 10% H_2SO_4* temperature, 150-190 F.	Pickling tanks are constructed of concrete, wood, steel or brick, lined with lead, rubber or an asphalt material, or are made of stainless steel or Monel. Lined wooden tanks are usually cheapest; lined steel tanks are common; tanks of stainless steel or Monel are the most expensive. Adequate ventilation must be provided to remove acid fumes. Agitation decreases pickling time and saves acid; either the pickle solution or the work may be agitated. Stainless steel or Monel pickle barrels, mechanical agitating or conveyor equipment are used. Heating increases the rate of reaction; steam coils or electric immersion heaters are used, and the temperature control must be fairly accurate (plus or minus 5 F. for automatic continuous installations). Batch-type pickling equipment (where the work is immersed in baskets or trays), pickling barrels, and continuous automatic equipment for pickling sheet, strip, etc., are available. The continuous equipment requires close control of both the acid concentration and temperature. Since the spent acid solutions often cannot be dumped into streams or sewer systems, they must be either neutralized (with an alkaline material such as lime) before disposal, or run through a recovery system from which acid and iron compounds can be salvaged. Such recovery systems are expensive to build and maintain. (See Note 2 regarding inhibitors and passivating agents.) Since acid pickles will not "cut" through heavy grease or oil, an alkaline cleaning or a degreasing operation may be necessary prior to pickling. The time of treatment varies from 3 to 20 min.; however, immersion time may run up to 90 min. for heavily scaled parts or wrought iron pipe, etc. Generally, unskilled labor is used to load and unload pickle baskets, conveyors or barrels, and to tend the tanks.
	Heat-treated steel parts	Furnace scale may be removed by the following bath: cleaning agent, 8-10% H_2SO_4 temperature, 145-155 F.	
	Steel forgings	Forging scale is more difficult to remove, and the following descaling bath may be used: cleaning agent, 8-15% H_2SO_4 temperature, 150-160 F.	
	Stainless steel parts	If the parts have a coating of heavy oxide, the following bath may be used: cleaning agent, 7% H_2SO_4 (by vol.) 2% HCl (by vol.) temperature, about 150 F. When the parts have a light scale, this mixture may be used: cleaning agent, 11% HCl (by vol.) for every gallon of this aqueous solution add ¼ lb. HNO_3. temperature, about 150 F.	
	Light gage sheet steel	Light scale can be removed and sheet steel etched prior to drawing with a pickle of the following composition: 2-4% H_2SO_4 2-4% $Fe_2(SO_4)_3$	
Electro-pickling	Iron and steel parts (especially heat-treated parts)	Electropickling is used to remove scales that are difficult or impossible to remove with still pickling. The work is made cathodic in a bath of the following characteristics: concentration, 10-20% H_2SO_4 current density, 10-150 amps. per ft.^{2} temperature, 50-150 F. time, 1-3 min. In one commercial process, this is followed by an anodic treatment under the following conditions: concentration, 40-50% H_2SO_4 current density, 100-150 amps. per ft.^{2} In another commercial electrolytic descaling process, a thin film of lead or tin is deposited from the bath on the bare iron or steel as soon as the scale has been removed; this protects the base metal from acid attack and insures dimensional accuracy.	Pickling time is reduced (usual total time is 1 to 5 min.), less acid is used, the tendency towards hydrogen embrittlement is lessened, and attack on the cleaned base metal is retarded (as compared to still pickling) in several electrolytic pickling processes. The savings in metal and acid may exceed the cost of power consumed. Both the temperature and concentration of the descaling bath must be closely controlled. The electrical equipment is expensive, and all electrical contacts must be maintained in good condition. Either unskilled or semiskilled labor may be used in this process, depending upon the type of installation. The speed and efficiency of this type of process has made it relatively popular in high production plants.

*Note 1. *All acid pickle bath concentrations are expressed in percent by weight in an aqueous solution. The symbols used for the various chemicals are:*
H_2SO_4 for sulphuric acid; HCl for hydrochloric (muriatic) acid; HNO_3 for nitric acid; and $Fe_2(SO_4)_3$ for anhydrous ferric sulphate.
Note 2. Inhibitors, usually synthetic organic chemicals, are added to acid pickle solutions to retard the attack of the acid on the clean metal areas without seriously reducing the rate of rust or scale removal. Counterbalancing the added cost of the inhibitor and the somewhat increased pickling time are the savings caused by the reduction in metal loss and in amount of acid used; hydrogen embrittlement is also decreased.

Passivating agents are added to pickle solutions to retard the attack on fixtures and tank and yet allow efficient pickling action. If stainless steel equipment is used, 1 to 5% anhydrous ferric sulphate added to the acid bath will extend its useful life.

Compiled by Robert S. Burpo, Jr.



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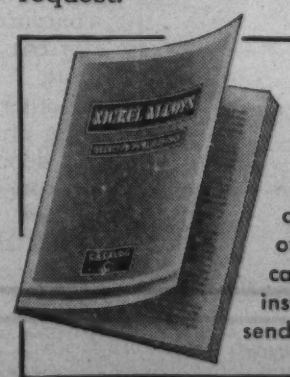

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NUMBER 56
August, 1944

Correlation of Physical Properties of Steels

In considering the physical properties of steels in their various forms, there are a number of handy methods for their correlation and/or calculation. Especially during the preliminary stages of design are approximations regarding comparisons of steels or correlations of certain properties helpful. Many of these correlations are averages and must be used with caution; they do, however, furnish ready information as to the properties and merits of ferrous materials.

Property and Definition	Relation to Other Physical Properties	Materials for Which the Relation is Applicable
Tensile strength — The maximum load carried by a sample undergoing test divided by its original cross-sectional area. See also Note 1	Tensile strength=2 x (yield strength)	Cast carbon steels
	Tensile strength=1.5 x (yield strength)	Hot rolled steels
	Tensile strength=1.15 x (yield strength)	SAE steels having 0.30-0.45% C (both oil and water quenched) with tensile strengths up to 200,000 p.s.i.
	Tensile strength=515 x (BHN) *	Hot rolled, low carbon steels
	Tensile strength=493 x (BHN)	Hot rolled, normalized or annealed medium carbon steels
	Tensile strength=480 x (BHN)	Heat treated carbon and alloy steels below 250 BHN
	Tensile strength=470 x (BHN)	Heat treated alloy steels of 250-400 BHN
Yield strength — The stress that will just produce a permanent "set" or extension of 0.2% of the original gage length	Yield strength=0.7 x (tensile strength)	Hot rolled steels
	(See also items 1 and 3 above)	
Endurance limit — The limiting stress at which the material can withstand (without fracture) an indefinitely large number of applications of completely reversed stresses. See also Note 2	Endurance limit=0.6 x (tensile strength)	Wrought steels having tensile strengths of 50,000-80,000 p.s.i.
	Endurance limit=0.5 x (tensile strength)	Cast irons
	Endurance limit=0.45 x (tensile strength)	Cast steels
	Endurance limit in reversed torsion=0.55 x (endurance limit in tension-compression)	Wrought steels
Torsional properties — (Stresses applied in torsion)	Torsional strength=0.6 x (tensile strength)	Average for static tests on steels
	Maximum elastic shearing stress in torsion=0.67 x (elastic limit in tension)+4000	Steels having a maximum tensile strength of 200,000 p.s.i.
	Maximum shearing stress in torsion=0.67 x (tensile strength)+25,000	

** These tensile-hardness relations (items 4 to 7, incl.) may be averaged to tensile strength=500 x (BHN) for a given hardness within the range of 100 to 300 BHN. The normal variation in tensile strengths (when different samples of the same type of steel, or different types of steels having the same hardness values are compared) is plus or minus 5 to 7%; similarly, within the range of 300 to 500 BHN, the expected variation in tensile strengths is plus or minus 7 to 8%. These figures are for SAE steels having 0.30 to 0.50% C content.*

Note 1. Cold drawing increases the tensile strength of plain carbon SAE steels (with 0.20 to 0.35% C) about 25% as compared with the same steel in the hot rolled condition; the tensile strength of free-machining steels (screw stock) may be increased up to 50% by cold drawing. The tensile strength of cold-drawn steels can be further increased by stress-relieving at 500 to 600 F., while heating above 1000 F. will destroy the improved physical properties gained by cold working.

Note 2. The endurance limit of a given part can be improved by case hardening or by giving it a finer surface finish. Table I shows the improvement in endurance limit caused by nitriding the test piece.

Note 3. The effect of the surface conditions on a series of steel samples expressed as percentage of the endurance limit of a highly polished steel bar (which was taken as 100%) is given in Table II.

Table I

Type of surface on test piece	% increase in endurance limit of nitrided specimens compared to unhardened parts having same type of surface
Smoothly polished	15
Having a fillet (0.04 in. rad.)	90
Sharply notched (sharp "v", 0.004 in. deep)	90

Table II

Surface Condition	Tensile strength in p.s.i.			
	50,000	100,000	150,000	200,000
Mirror polished	100	100	100	100
Polished	95	90	88	87
Machined	92	83	77	72
Sharp circular notch	86	72	58	43
With mill scale	76	53	39	30
Submerged in ordinary water	66	41	28	18

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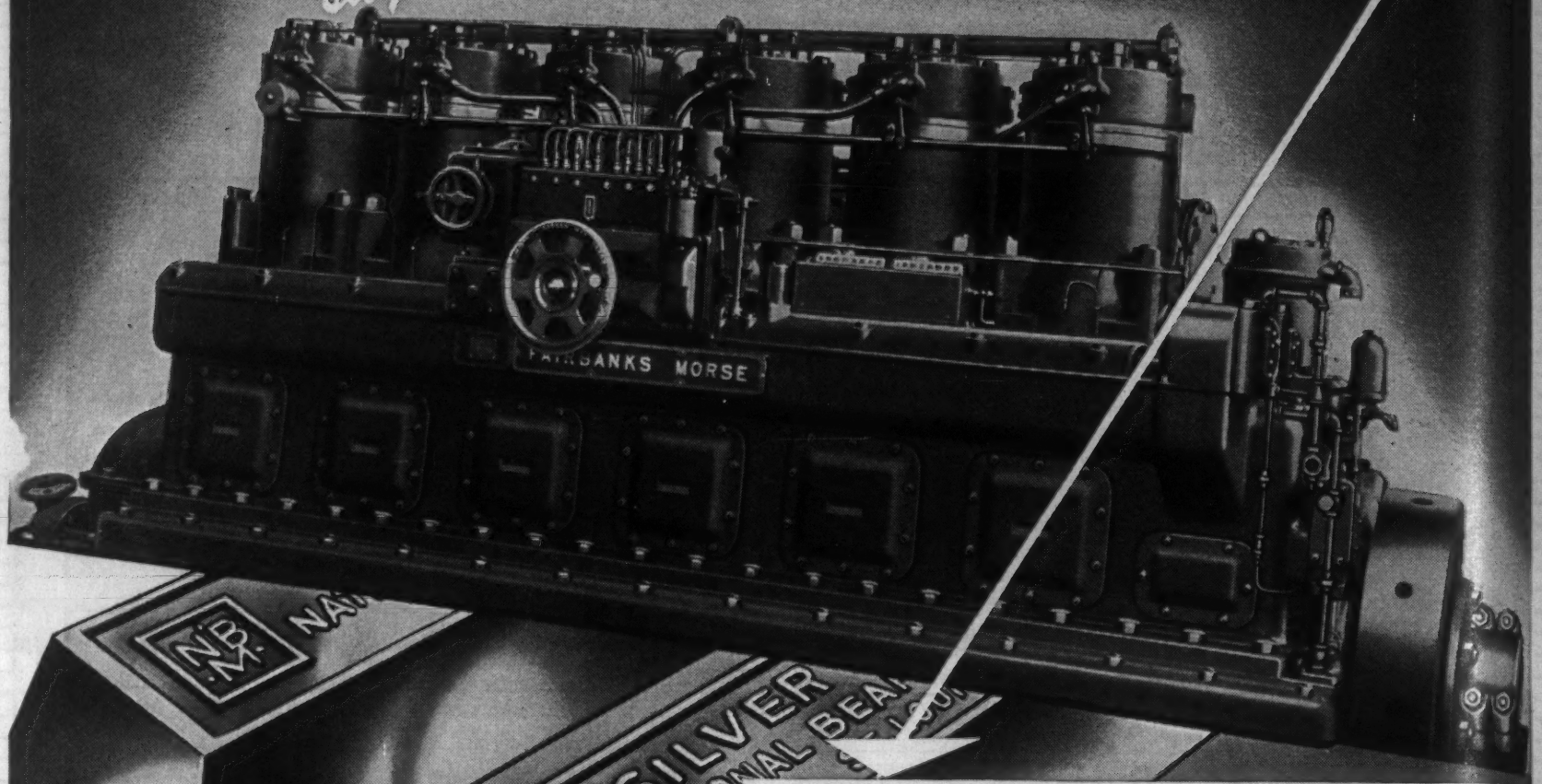

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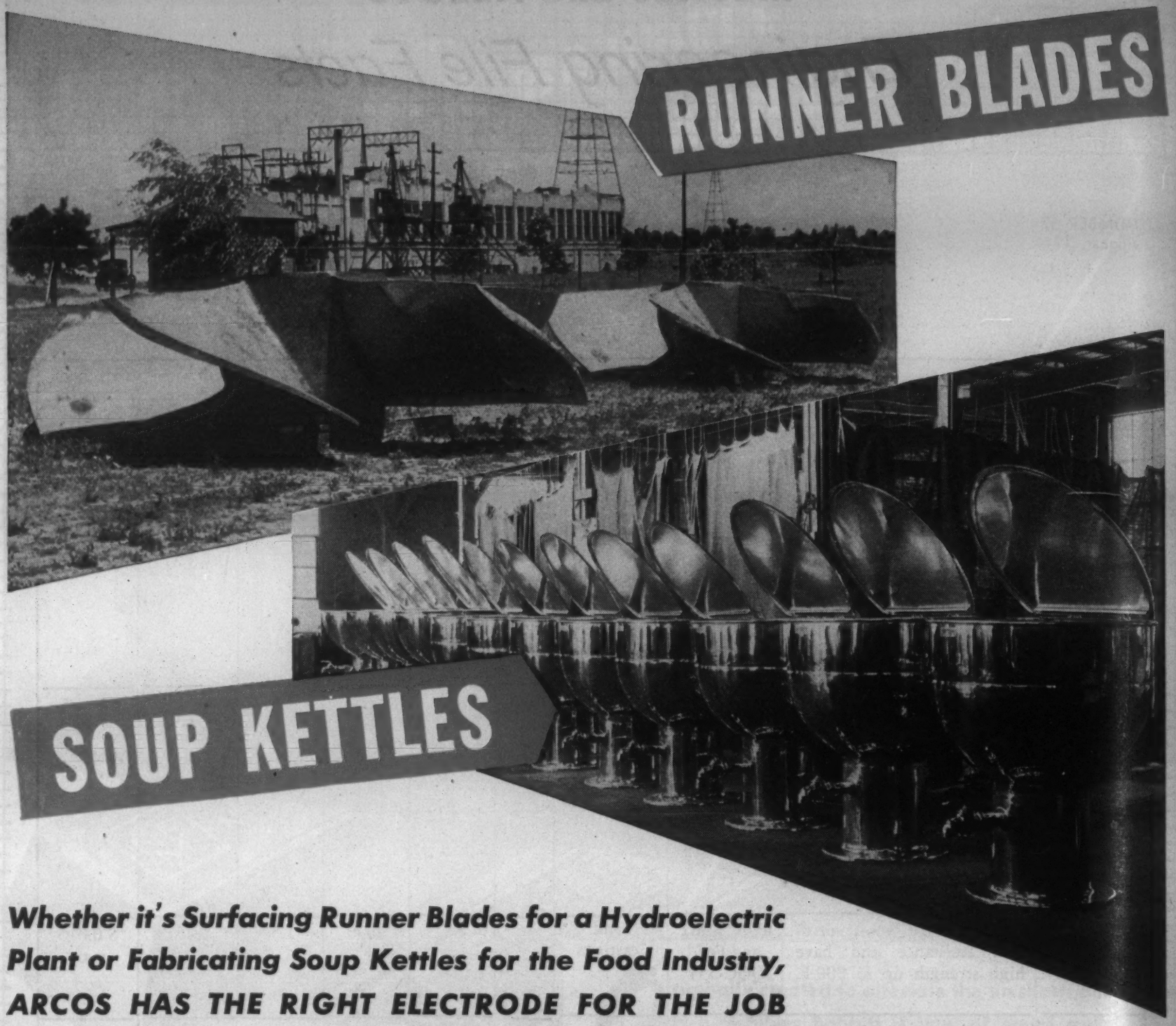
NUMBER 57
August, 1944

Nickel-Copper Alloys

A Digest of Common Specifications (40-90% Ni)

Name	Characteristics or Uses	Specification	Form	Composition, Per Cent					
				Cu	Ni	Mn, Max	Fe, Max.	Si, Max.	Others
	Sometimes used for the plate in diode vacuum tubes	——	Wrought	10	90	——	——	——	——
"B" Monel	Has high resistivity, low temperature coefficient of resistance, excellent corrosion resistance and good mechanical properties; can be cold or hot worked; also used in cast form	USN 46M7 (int)	Wrought	Rem.	63.00-70.00	2.0	2.5	0.50	S 0.02 max.
"R" Monel	This alloy has many of the physical properties of "B" Monel—some toughness and strength has been sacrificed for increased machinability; produced as cold drawn or hot rolled rods for screw machine use; cannot be hot headed or forged	USN 46M7 (int)	Wrought (Free machining)	Rem.	63.00-70.00	2.0	2.5	0.50	S 0.025-0.060
	Castings have good corrosion resistance and have high strength up to 800 F.	USN 46M1 and Fed. QQC-551	Sand castings	29	67	0.90	1.5	1.25	S 0.015 max.
"K" Monel	Has good resistance to corrosion, and its mechanical properties make it especially valuable in the form of wire—may be cold or hot worked, and can be heat treated	——	Rod, strip and wire	Rem.	63.00-67.00	1.00	2.00	0.50	Al 2.00-4.00
"H" Monel	Has good strength and ductility and can be heat treated	——	Cast	29.5	65	0.5	1.5	3.0	S 0.015 max.
"S" Monel	This alloy has higher hardness and is resistant to galling action; its ductility is lower; may be heat treated	——	Cast	30.0	63.0	0.5	2.0	4.0	S 0.015 max.
Constantan	This alloy has the highest resistivity, lowest temperature coefficient of resistance, and highest thermal e.m.f. (against platinum) of the Cu-Ni alloys; used in electrical resistors and thermocouples	——	Cast and wrought	54-56	44-46	——	——	——	——

Compiled by Robert S. Burpo, Jr.



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"QUALITY WELD METAL EASILY DEPOSITED"

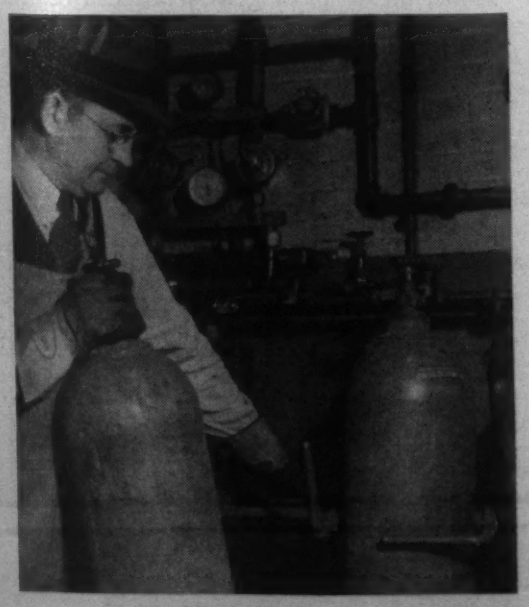
METALLURGICAL ENGINEERING shop notes

Storing Gas Cylinders Safely

by C. J. Zetler, Jr.
Westinghouse Electric & Mfg. Co.

The safest method of storing compressed gas cylinders within manufacturing departments when empty or fully charged is to provide a rack and store them vertically. With the variety of racks now in general use, it is usually necessary to use a chain or gate to hold the cylinders securely in the racks. In either case, the fastening of the chain or gate is an extra operation that is sometimes neglected.

Recently, a new rack was designed by the Works Engineering Department, East Pittsburgh plant, Westinghouse Electric & Mfg. Co., and several were installed in the oxygen and hydrogen generating plant.



The safety factor is the retaining feature provided each compartment. This consist of cranks that securely retain the cylinders in the racks and that are counterweighed by the angles of the cranks. After the cylinders have been placed in the compartments of the racks, the design of the cranks, in which counterweights are involved, causes them to close the compartments provided for the cylinders.

Use of a cascade of water to carry off excess paint from spray guns has salvaged 75,000 gal. of enamel, enough to paint 30,000 "jeeps" at Willys-Overland. Each jeep is painted by passing between manually-operated spray guns and the waterfall. The water catches excess paint spray, carrying it into a wash system, where it is removed from the top of the water, then reprocessed. The recovered paint sludge also contains fats, oils, glycerine and phthalic anhydride, which are recovered. In 18 months 97,500 lb. of vegetable oil, 60,000 lb. of anhydride and 30,000 lb. of glycerine were salvaged.

—News release from Willys-Overland Motors, Inc.

Modern Welding Rod Oven Design

by O. Byron,
J. O. Ross Engineering Corp.

Not so very many months ago the Navy pronounced welding rod manufacture a serious bottleneck, and strenuous steps had to be taken to increase production. This centered attention on need for faster equipment, including coated welding rod baking ovens. Certain principles were formulated and put into practice.

Thus, the design should permit flexibility of operation, producing up to 1200 rods per min. on a high production schedule, or a few hundred rods for alloy rods. Exactness of control must be maintained over heat, air circulation and humidity.

In a typical modern universal type multiple pass conveyor oven, each conveyor pass is independently driven by a variable speed drive, remembering that rods have different drying characteristics.

A typical 5-pass oven is arranged for three zones of control. Initial zones are arranged for humidity control, and a centralized heating system permits higher heat concentration where needed.

Large volumes of air are circulated and recirculated. Sometimes the circulated air comes from specially designed ducts running the full length of each pass of the oven. This provides rapid drying without initial hardening. Often a cooling zone is located near the exit so that the rods can be packed immediately.

The modern oven design incorporates a device for carrying rods from one conveyor pass to another without jamming. Thus, in the Ross "Universal" oven, rods are picked up slowly by a series of blades attached to an independently driven conveyor, carried down to the next lower oven conveyor and gently deposited. The slight rolling motion does not gouge or mark the coating.

Ovens vary in size and materials, depending on the job to be done. Thus, an oven turning out 1200 rods per min. is 135 ft. long, with 5 passes of conveyor; an oven for alloy rods is 35 ft. long.

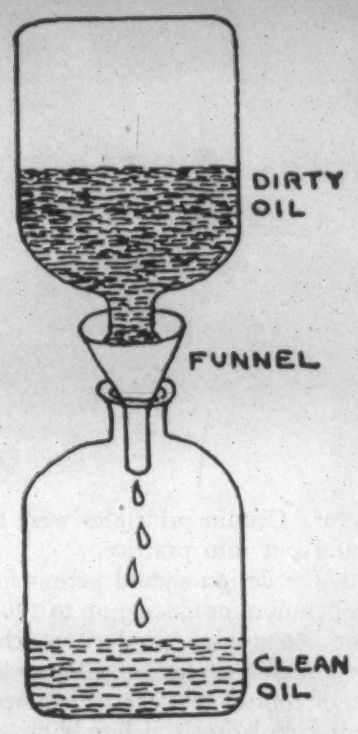
A typical oven is constructed of insulated panels, made up with two metal sheets separated by an insulating material. Construction permits a choice of metal thickness, or if to be corrosion resistant, of materials such as galvanized, or stainless, steel. Designs provide for a complete shop fabrication, rapid field assembly and ease of enlarging or relocating ovens.

Simple Filter for Oil, Etc.

by W. F. Schaphorst

The accompanying sketch shows a handy home-made filter, useful for cleaning quenching or lubricating oil and other liquids. Two bottles, a funnel and filtering material are all that are needed.

Filter paper would be satisfactory for some liquids. Terry cloth, used in grease



extractors in power plants, is another possibility. Or a filter that is much used in chemical industries might apply—a metal filter cloth for backing with another filtering medium on top, which method might require a larger funnel than is depicted here. Sometimes ordinary waste can be used.

At any rate, place the funnel with its filter into the lower bottle and invert the bottle containing the liquid, placing it in such a position that it will gradually and automatically feed while the liquid filters.

If an unusually fine job is desired, the bottles can be reversed, possibly a fresh filter added, and the process repeated. The principal is sometimes called the "vacuum font."

One of the ideas adopted from one employee's suggestion at Consolidated Steel Corp. was a plastic pipe, used as a water level for constant accuracy in aligning jigs on skids. An engineer's level had been used previously.

—"Labor and Management News"

Chief Reasons for Fine Finishes

by F. E. Hewens,
Wright Aeronautical Corp.

Beautiful mirror-like finishes on mechanical parts are not there to appeal to the eye. In fact, most of the highly finished parts are out of sight, as in the cyclone aircraft engines that our company build. Inasmuch as this is an era of super-fine, smooth surfaces and finishes, it is well to consider the reason for them so that we planners and workers will strive harder to produce them accurately.

A microbe, with its chin a scant eight millionths of an in. above its feet, could not walk across a ballroom floor without the use of a microbe's mountain—climbing equipment. But a microbe could walk up the inside of an airplane cylinder barrel in its bare feet, everything seeming flat to the microbe except an occasional slight ripple, like the lines between flagstones in a sidewalk.

In bygone years of ponderous, earthbound engines, moving metal parts were not finely surface-finished. Outer surfaces of parts not subject to friction were often roughened so that paint would cling better. But in those days power in proportion to engine weight was low. The surface had a function as frivolous as the gleam upon it—a surface was polished only to make it easy to look at.

In the development of the airplane, however, man could not afford the luxury of mere prettiness. Engineers had to make every portion of every part play its role in bearing the burdens of power production. The surface became as fully a stress-bearing member of the team as the interior. A break in the surface could become a starting point for a break extending through the whole part.

Importance of the perfect surface can be demonstrated in the laboratory, by the photomicrograph, chemical analysis and the tensile testing machine. But let's mention a simple test. Try to tear the unbroken edge of a piece of heavy canvas. The force required would be tremendous. But snip into that edge with scissors first—then see how easy it is to tear.

Examine an unfinished metal surface under a microscope and the surface becomes a panorama of jagged peaks and valleys. Suppose this surface was the outer face of a rod or crankshaft of an airplane engine. Each of the valleys would be a "scissors-snip." Each valley would be like the scratch in a piece of glass etched by a glass cutter's tool; a sharp blow would break the glass along the scratch.

The absence of surface flaws has an amazing effect. A test bar of metal, with its surface scratched will usually break in a tensile testing machine at a stress far less than the stress withstood by a thinner sample with an unscratched surface.

Hence, there are now many steps in engine manufacture which, a few years back, would have been looked on—not as super finishing, but as super-frivolous.

Here then are some wise precautions in engine manufacture. Workers must not wear rings lest their jewelry scratch the parts; cradle crankshafts in fabric-bound racks, their ends tenderly placed in cotton socks; many parts and accessories coming to the assembly line should be intricately packed in cartons and paper, the wrappings being broken open only when the parts are ready for use.

The plant must not be penurious in the purchase of such apparatus as honing equipment, lapping machines, buffers and polishers. And don't forget the delicate electrical devices such as surface analyzers, and profilometers that move their sensitive mechanical fingers across newly-gleaming surfaces to measure variations in surface as small as three one-millionths of an in.

Sharp edges are in a class with peaks and valleys on surfaces, and must be rounded off.

Finally, what applies to surfaces and edges of aircraft engine parts, applies to many lines of precision manufacture.

Self-sharpening mill knives, such as used in the paper industry and elsewhere, can be made inexpensively from steel plate by any well-equipped welding or machine shop. The principle is that when a knife that has a core of hard, abrasion-resistant alloy is set in a base of less wear-resistant material, such as mild steel, it will sharpen itself as the sides wear away a little at a time, leaving the hard alloy cutting edge exposed and sharp. A good core is Stellite cobalt-chromium-tungsten hard-facing rod. The hard core and mild steel layers are applied by welding.

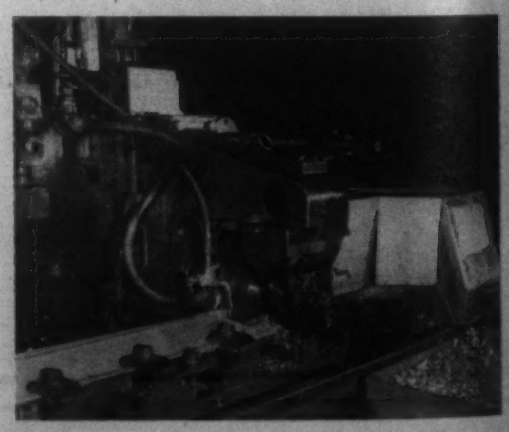
—"Oxy-Acetylene Tips," Linde Air Products Co.

Removing Chips by Air

by John Emberly,
Glenn L. Martin Co.

A new attachment provides that twin jets of air are directed on each side of an extrusion milling machine cutter by means of copper tubing. The air current carries the chips into a duct attached to the machine, thence passing from the end of the duct into a mobile receptacle.

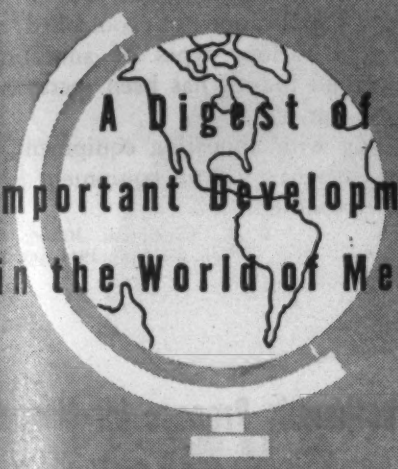
Previously, one worker constantly brushed the chips from the bed of the



milling machine, but this man is now relieved for other duties. The device maintains a clean ship and keeps chips off the floor that formerly burdened the sanitation department.

Finally, scrap is segregated at the source, and chips are not contaminated by dirt and chips of other types of metal.

Metallurgical Engineering Digest



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1 Metal Production

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Copper Alloy Production

Condensed from "Mining and Metallurgy"

For years practically all copper alloys to be wrought have been melted in low-frequency induction furnaces. No change has occurred in this situation, although in new war plants the tendency is to install much larger melting units than heretofore were common. The advantages are: (1) Melting rate of metal per hr. is increased, (2) electrical energy consumption per ton is lower, and (3) larger cakes or bars are cast.

Recent use of water-cooled molds with copper linings was found to give a greater life, and a better quality of cast surfaces is produced.

A new development in cold-rolled metal production is to cast bars 2 or 2¼ in. thick and 18 to 25 in. wide, weighing up to 1000 lb. Mill treatment consists of breaking down cold, usually in four passes, to about 1 in. thick on 2-high mills having 24 to 26 in. diam. rolls and operating at a speed of 115 ft. per min.

After annealing, the bars are run down in the same mill in three passes to ½ in. or less. Intermediate rolling, as well as finishing down to 3/16 in., is carried out on 4-high mills driven by 100-hp. motors, with about 15 in. rolls, and a speed of 200 ft. per min.

For finishing from 0.200 in. to 0.030 in., 4-high mills are used. For thinner gages, 4-high mills with about 8½ in. rolls and variable speed are found best. For miscellaneous small lots, fast 2-high roller bearing finishing mills are used.

Modern mills are designed to cakes at least 4 to 5 in. thick and weighing at least 2000 lb. Width has been increased from 18 to 25 in. Heavier mill equipment is also being used.

Hot rolling of cartridge brass is accomplished from the cast size in about 11 passes to about 0.450 in. thick. The metal is then cold rolled to finish gage of 0.256 in. for .50 caliber, or to 0.134 in. for .30 caliber cases. For artillery cases, a great deal of metal has been hot rolled practically to the finish gage.

In the manufacture of tubes, a notable development is the increased use of hot piercing mills for alloys. Such alloys include 70-30 brass, red brass, commercial bronze and cupronickel.

An interesting development brought forth by the war is the use of high-velocity forced convection furnaces. They are well adapted to the intermediate annealing of cartridge cases. The furnaces are now available for actual metal temperatures up to 1500 F.

Also, application of controlled atmosphere in various types of annealing for copper and brasses has been increased during the war.

Along with annealing equipment, much more efficient pickling equipment has also been introduced.

—D. K. Crampton, *Mining & Met.* Vol. 25, June 1944, pp. 297-300.

Carbothermic Process for Magnesium

Condensed from "Western Metals"

The carbothermic method for production of magnesium, so called because it employs carbon and heat, was worked out by Dr. F. J. Hansgirg, Austrian metallurgist, and adopted for the Permanente, Calif., plant by Henry J. Kaiser. Raw materials are obtained from the dolomite quarries at Natividad, Calif.; the sea water treatment tanks at Moss Landing, and the reduction plant at Permanente.

Operations began at Natividad, where dolomite is quarried and calcined at 2000 F. This material is then taken to Moss Landing, where it is mixed with sea water in thickeners. The mixture becomes magnesium hydroxide slurry.

Filtration removes the solids, and the cake is dehydrated in rotary kilns at 2300 F. The resulting material is more than 96% magnesium oxide. It is trucked to Permanente.

A mixture of this oxide and petroleum cope is ground in a ball mill, made into small pellets, and fed into 8000 kva. reduction furnaces. Here, at a temperature of 3600 F., the magnesium oxide combines with the carbon to produce magnesium and carbon monoxide.

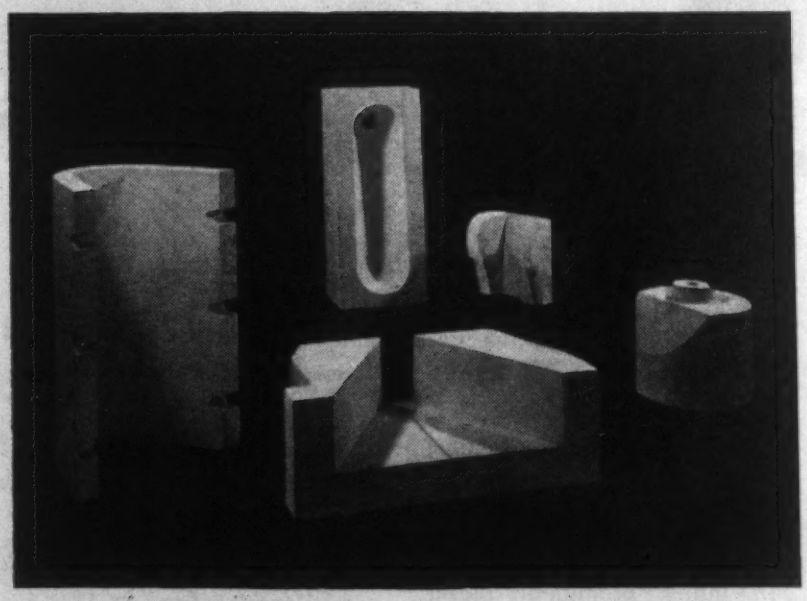
To prevent this reaction from reversing at lower temperature, the gaseous mixture is shock-chilled to 390 F. by a stream of natural gas. Magnesium is in the form of a fine dust, and is extremely inflammable, so that oxygen must be completely excluded.

A battery of bag filters removes the metallic dust, which is conveyed to bins and later to gas-tight pelleting presses for consolidation. Distillation in vertical air-tight electric furnaces at 1400 F., at a pressure of 0.2 mm. mercury, produces a crystalline magnesium of 99.99% purity. This metal is cast into ingots of any alloy desired.

"SHAMVA" MULLITE increases production 2 ways

In open hearth, electric steel, cupola, gray iron, non-ferrous and ferrous alloy melting, "Shamva" Mullite promotes definite production increases, while substantially conserving man hours in the repair crew.

MAXIMUM REFRACTORY LIFE PROMOTES MAXIMUM PRODUCTION



Spouts, troughs and pouring boxes must fill one of the most severe service requirements in the metals field. These "Shamva" Mullite shapes—made in wide variety, give superior service life.

TRADE MARK

"Shamva" Mullite SUPER-REFRACTORIES

Distinctive Features of "SHAMVA" MULLITE:

- High softening and fusing point: fuses at 3335° F.
- Minimum expansion and contraction
- Low heat conductivity.
- Resistance to spalling.
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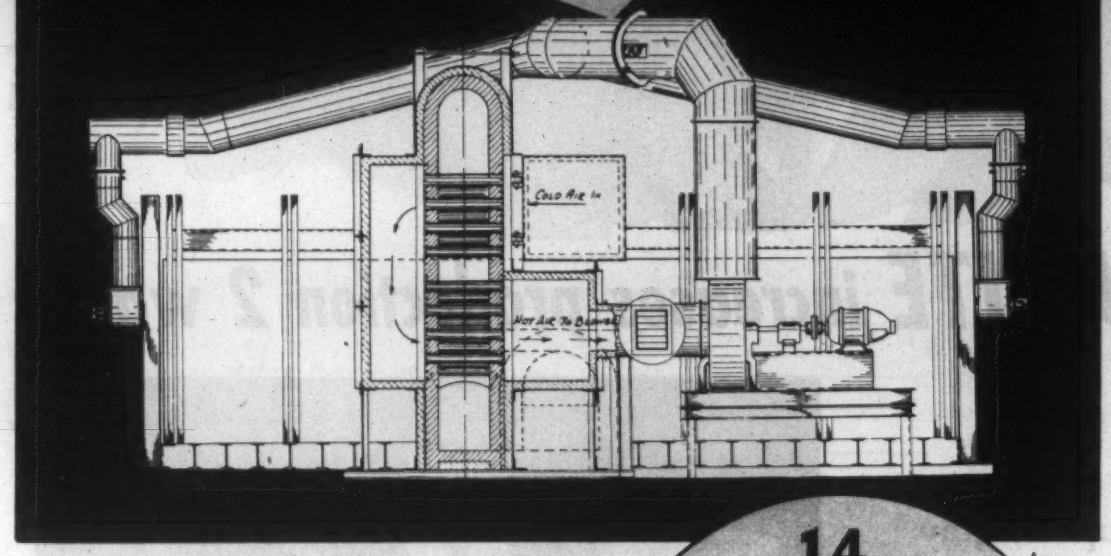
- Resistance to slag and abrasion.

THE MULLITE REFRACTORIES CO., SHELTON, CONN.

Pioneers in Mullite Super-refractories

Brick, Special Shapes, Cements for Every Furnace Requirement

PRODUCTION IN THIS BATCH TYPE SLAB HEATING FURNACE WAS *Increased* FROM 600 TONS PER WEEK *to* 900 TONS PER WEEK



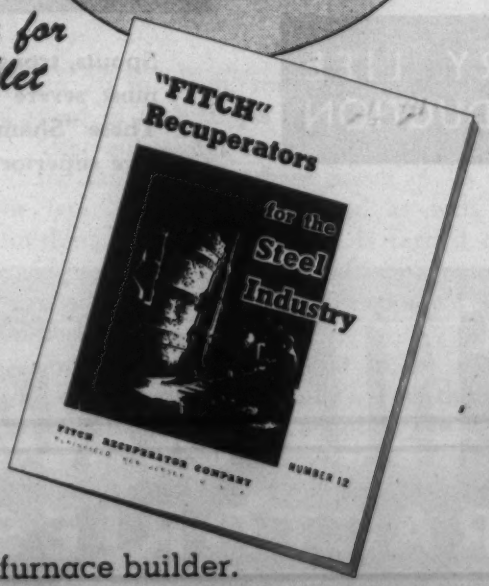
14 of the Largest Steel Companies use FITCH RECUPERATORS

On a plate mill furnace this company changed from a regenerative type furnace to a recuperative type, using a Fitch Recuperator . . . *and increased production 50%!*

Three other companies with furnaces of this type, using cold air for combustion of fuel, installed Fitch Recuperators and increased firing rate and production.

In many prominent plants, large numbers of various designs of Soaking Pits and Continuous Re-Heating Furnaces are equipped with Fitch Recuperators. These plants switched to Fitch because they found Fitch Recuperators permitted greater heat transfer, lasted longer without repairs and that when repairs were eventually necessary, they were made by simply replacing tubes in a few hours' time.

Write for Booklet



Write today for our Booklet No. 12. It illustrates installations on many types of furnaces. No cost and no obligation.

We do not build furnaces—see your furnace builder.

FITCH RECUPERATOR CO.

Plainfield National Bank Bldg., Plainfield, N. J.

Carbon monoxide released in the furnaces is carried away in the stream of natural gas. The gas is later used for fuel in the kilns of the Permanente Cement Co.

Because powdered magnesium is very inflammable, all operations after the metal is obtained from the oxide must be carried out in an atmosphere of natural gas. The entire process is therefore enclosed.

Kaiser engineers have eliminated all the earlier difficulties and are making improvements in the process to increase production and lower costs.

—*Western Metals*, Vol. 2, May 1944, pp. 36, 37, 39.

Lubrication for Blast Furnaces

Condensed from "Blast Furnace and Steel Plant"

A centralized lubricating system for blast furnaces is advantageous because it delivers the lubricant under pressure to every bearing from one stage central point, each bearing getting the proper amount of lubricant. This system not only keeps men out of the danger zone, by providing complete lubrication from the hoist room, but it also eliminates one of the principal sources of gas leakage by giving proper lubrication to the packing seal on the distributor ring.

Clean lubricant is served to all bearings through a closed system of piping, starting with the barrel transfer pump and ending with the final bearing convection. The drum may be covered with dirt, but fresh lubricant is still delivered to the bearings on the furnace top, without any chance of contamination.

Signal lights between two pumping units are operated by a pressure control valve on the top beyond the last lubricant measuring valve. The control valve insures that, even on the coldest day, sufficient pressure is developed to overcome the resistance in the supply lines and to operate every lubricating valve, before the signal light will operate.

All main header piping should be accompanied by a separately wrapped steam tracer line, and all bundled together and covered by a protective jacket of insulating material. Header piping should be at least 1¼ in., and preferably 1½ in., otherwise it is impossible to move the lubricant on very cold days.

Installations of manually operated systems have been made on stock house line shaft bearings that operate the feed bins. This makes a good application, for there are about 250 2 in. x 5 in. sleeve-type bearings to be lubricated each 8 hr. This is accomplished in 5 min., with each bearing getting a measured charge.

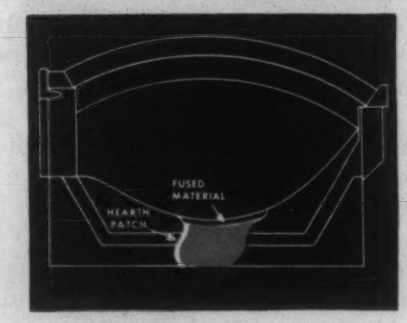
A 400-lb. drum of grease is connected to a central pumping unit, and will last 6 months. With the old hand method each bearing was visited three times a day.

As a result of giving all bearings regular attention, centralized systems do a good job, insure production, preserve equipment, save critical materials and provide safety for the oiler.

—A. J. Jennings, *Iron & Steel Engr.*, Vol. 21, May 1944, pp. 42-46.

Don't let them down

Keep Open Hearths Going with HEARTH PATCH



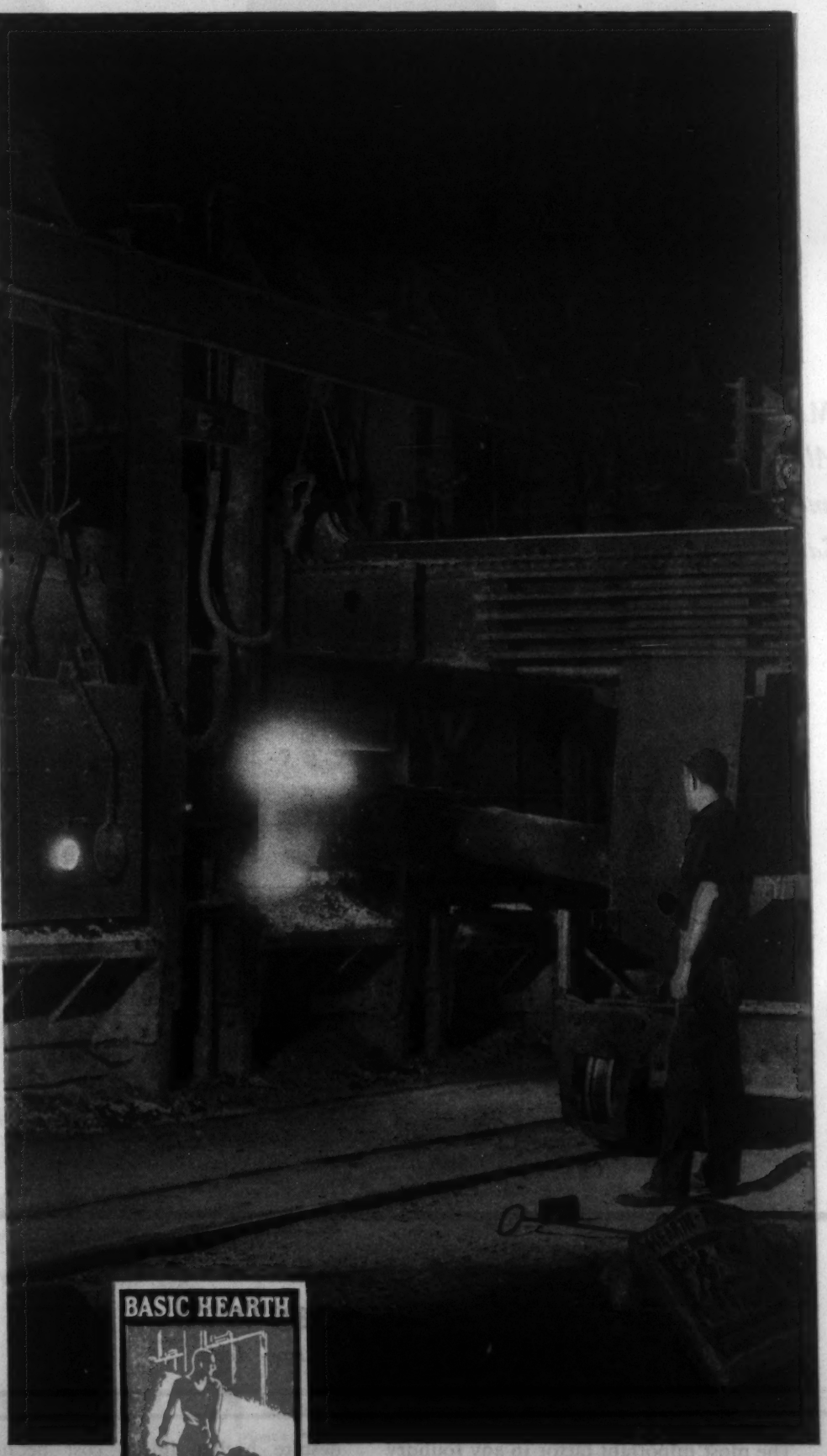
"Don't let them down" is America's charge to industry, as our armed forces drive toward Victory. "Don't let them down" means keeping up ingot production, keeping open hearth furnaces on the line.

How can an open hearth be kept on the line—when the bottom gets old, when deep holes show up? In many shops, the answer is Hearth Patch.

Hearth Patch is a fine-grained, fast-setting, magnesia refractory designed to do one job—to repair deep bottom holes. To patch a hole with Hearth Patch, just clean out slag and steel and dump in bags. Don't cool the furnace. Don't use any slag. Fill hole level full of Hearth Patch, cover with two inches of dolomite, and burn in for two hours. The patch settles down, fully consolidated and you're ready to charge.

Or if you can spare the time, you may, as some operators do, burn in Hearth Patch by the conventional method for fusing magnesite, to make an extremely dense, permanent type of repair.

Hearth Patch has been improved continuously since its introduction four years ago. Today it is outstanding among quick-setting refractories for its high degree of fusibility, refractoriness and stability. You can use it with confidence to prolong the useful life of old open hearth bottoms, when America needs every possible heat of steel.



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2 Foundry Practice

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Magnesium Foundry Sand Control

Condensed from "The Iron Age"

The most important factor in any foundry is its sand practice. This is especially true in magnesium alloy sand casting because (1) at present all magnesium alloy castings are diverted to aircraft construction, and must have a smooth surface finish; (2) inherent low density of the alloy; and (3) magnesium oxidizes above its melting point.

American foundries favor synthetic sand despite higher initial cost because grain size is easily controlled; it is free of clay, organic and other foreign material.

Good results are obtained from sand prepared from quartz, and having an average A.F.A. grain fineness of 68 to 80. Permeability should be 110 to 150 and compression strength of 6.5 to 8.5 p.s.i.

In order to keep down moisture to the lowest possible point, because magnesium reacts with moisture, many foundries introduce into the mold, just prior to pouring, a reducing gas such as sulfur dioxide. This minimizes oxidation of hydrogen and subsequent formation of water. At present, best results are obtained by using ammonium silicofluoride.

When using sand with grain fineness of 70 to 80, good results are obtained by maintaining inhibitor concentration at 0.65 to 1.0 S, 1.0 to 1.5 boric acid, 2.5 to 3.5% ammonium silicofluoride. To be effective, these inhibitors should form an inert gas, reduce the fusing point of the sand, and coat grain particles.

Best results are obtained by use of a mechanical mixer for mulling. Mulling time will vary with the job, but it is always best not to under-mull.

Cautions to be observed are: (1) Sulphur should be low; it retards flow of metal and high concentration results in misruns and cold shuts; (2) heavy concentration of ammonium silicofluoride will cause sand to harden in lumps; chemical check should be made daily; (3) excessive use of bentonite makes sand "gooey" and sticky; (4) Particles of rust should be kept out of sand because they cause blows; and other foreign substances should also be kept out; and (5) old sand should be refreshed to maintain grain fineness.

Bentonite should be added only after a compression test shows that it is needed. Undermulling gives the appearance of weakness and, therefore, mulling time should be increased before bentonite is added. Dropping copes may be due to high moisture content and not to sand weakness. Compression and permeability tests should be made every hr.

—Oscar Blohm. *Iron Age*, Vol. 153, May 11, 1944, pp. 74-77.

Slip Coated Foundry Sand

Condensed from "Foundry Trade Journal"

In a study of foundry sand problems it was considered necessary to cover each sand particle with a film of clay without crushing or grinding. The clay was introduced as a watery suspension. To keep down water content the clay was first converted into a colloidal casting slip by the addition of deflocculants, the proportion of water necessary for this purpose being low enough to yield fairly dry synthetic foundry sand.

It appeared that the addition of suitable amounts of electrolytes (deflocculants) added to the mixer containing sand, clay and tempering water resulted, after a very short mixing period, in a slip-bonded sand in which the colloidal clay slip would cover the sand surface completely. Toughness was thereafter re-imparted to the perfectly distributed clay by addition of another electrolyte (flocculant), so as to produce a particularly high green strength.

If a high dry strength were sought, the subsequent flocculation could be omitted. An English clay was used that yielded a

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perfect, creamy and stable slip on addition of 42.5% of tap water, 0.39% of ammonium oxalate and 0.1 of sodium silicate (syrup), calculated on a dry clay basis. The sand used was a graded silica sand $\left(\frac{16}{0}\ \frac{30}{2}\ \frac{44}{8}\ \frac{60}{28}\ \frac{85}{36}\ \frac{100}{12}\ \frac{120}{8}\ \frac{150}{2}\ \frac{200}{0}\right)$.

As a control test, the sand was mixed with 10% of its weight of dry powdered clay and 3.5% tempering water, and tested for green strength by the A.F.A. method. Mixing and testing were continued until the green strength remained constant, indicating that the maximum spread of the clay bond over the sand surface had been reached. Then, more water was added, mixed and tested again, etc., and the "normal" values were obtained for green strength at different moisture contents.

Low Green Strength

In a second experiment a mixture of 10% clay, 4.5% water and, as deflocculant, 0.05% ammonium oxalate and 0.01% sodium silicate (calculated as dry Na_2O_2 SiO_2) was used.

As expected, the green strength values—2.4 and 3.4 p.s.i. for 3 and 10 blows of the rammer were extremely low. Then was added, as a flocculant, 0.5% powdery hydrated lime mixed with 0.35% water. The sand mixture became warm, very dry to the touch, and the green strength rose to very high values.

Gradual additions of more water reduced this high strength only moderately, and the mixture containing 7.35% water was very similar in strength and apparent wetness to the "normal" mixture containing only 3.5% water.

Owing to the fluidity and low cohesion of the liquefied clay, sand bonded in this way can easily be rammed to give very high dry strength figures approaching those obtained with bentonite-bonded sand; but the green strength is low due to the lack of cohesion between the deflocculated clay particles.

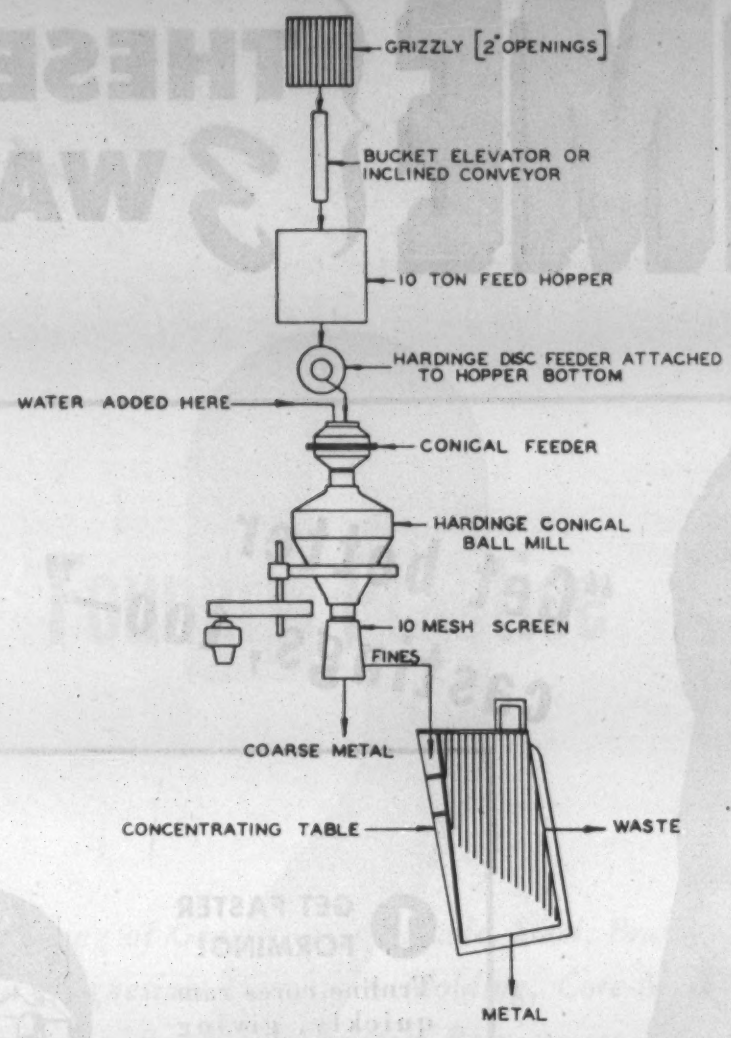
If the deflocculated clay coating is subsequently reflocculated, the green strength rises to very high values substantially above those obtained with raw clay by prolonged mixing. The dry strength figures are, however, very much lowered.

—Felix Singer. *Foundry Trade J.*, Vol. 72, Mar. 30, 1944, pp. 261-264; Apr. 6, pp. 285-288.

Magnesium Castings

Condensed from "Canadian Metals & Metallurgical Industries"

In melting magnesium at the Robert Mitchell Co., Ltd., of Montreal, two sizes of low carbon steel pots are used, with capacities of 70 and 150 lb. each. Stainless steel cannot be used because nickel will cause contamination of the magnesium. Pots usually fail because of scaling.



Recover Metals From Foundry Waste

The above wet grinding flow sheet illustrates one of the methods used in the recovery of non-ferrous metals from dross, ashes, floor sweepings and slag.

The metal may be recovered by either wet or dry grinding and a number of sized products obtained.

Write for Bulletin 8-A

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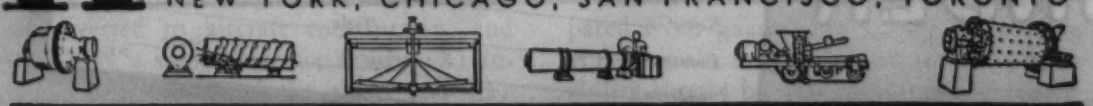

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A small amount of flux is sprinkled on the bottom of the pot, and the metal is charged in. When melting has reached an advanced stage, flux is spread on the surface to extinguish small fires. Burning should be prevented whenever possible.

When the molten metal has reached about 1300 F., it is stirred with an iron rod and more flux added for refining. The surface should be clean and silvery. If the surface is dull and frothy, refining operations must be repeated.

The refined metal is well covered with flux and superheated to 1650 F. for a few minutes, then allowed to cool rapidly to proper casting temperature, usually from 1400 to 1500 F. Superheating refines the grain and thus improves the mechanical properties of the alloy.

All flux and oxide scale must be removed from the pouring spout and surface of the metal. When the layer of flux is pushed back for pouring, temporary protection against burning is provided by sprinkling with sulfur or a sulfur-boric acid flux. A heel of metal is usually left in the crucible to minimize the danger of flux carry-over into the casting.

After cooling, the castings are shaken out, cores are removed, and gates and risers are cut off with metal-cutting band saws. The fire hazard is minimized by exercising proper precaution in collecting dust and grinding chips.

Most castings are heat treated to improve the tensile strength and elongation. Solution treatment consists of heating for 16 hr. at 730 F. in electrically heated forced-circulation furnaces containing a small percentage of sulfur dioxide, followed by air quenching.

After heat treatment, the castings are given a dimensional check. Aging for 16 hr. at 350 F. increases the yield strength but does not help other properties.

—*Can. Metals & Met. Inds.*, Vol. 7, May 1944, pp. 24-27.

Cast Iron Finned Cylinders

Condensed from "The Foundry"

Over 1500 finned cylinder castings are made daily at the Motor Castings Co., Milwaukee, using cupola-melted nickel-chromium and nickel-chromium-molybdenum irons with tensile strengths ranging from 30,000 to 50,000, p.s.i. minimum and hardness of 176 to 217 Brinell at the cylinder seat.

Finned cylinders are made in core molds using facing and backing sands of different specified compositions. Permeability, shear, dry and green strength, flowability, etc. are checked for each batch of sand as mulled and at the work benches. The sand muller is set with a timer that automatically ejects the sand at the end of the specified mulling time.

Molds and cores for the finned cylinders are made by hand and on jolt-rollover machines. Definite schedules are set up for the number of jolts to be given each mold. A minimum of nails is used in

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got what he wanted!

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stiffening the fins, but reinforcing wires are used in the cores behind the fins.

Vent wax is freely used to insure the removal of mold gases during pouring. Cores and core molds are moved on a roller conveyor and are dried in a vertical oven.

Core fitters assemble the cores to complete the mold using bosses and recesses in the cope and drag as locating points in closing the mold. The completed molds are stacked four-high, clamped between plates and trucked to the foundry.

The finned castings are molded horizontally and poured vertically. Pouring sprues are located at the end or side of the mold. Runner basins extending almost the full length of the assembly are used. A dam at the pouring end of the runner basin serves to hold back slag and dirt. The pouring is done on a conveyor.

The iron is tapped from the cupola in 1600-lb. charges into barrel-type insulated teapot ladles set up in front of the cupola. Temperatures are measured on the metal as it emerges from the spout, and the iron is held until the specified pouring temperature is reached. Temperatures are again checked and recorded as the metal enters the first and last molds.

A chill test block is poured and broken for each heat. Standard 1.2-in. arbitration bars are also poured to supply samples for chemical and physical tests of the iron in each ladle.

—Edwin Bremer. *Foundry*, Vol. 72, June 1944, pp. 116-120, 254.

Solidification of Malleable Iron

Condensed from a Paper of the American Foundrymen's Association

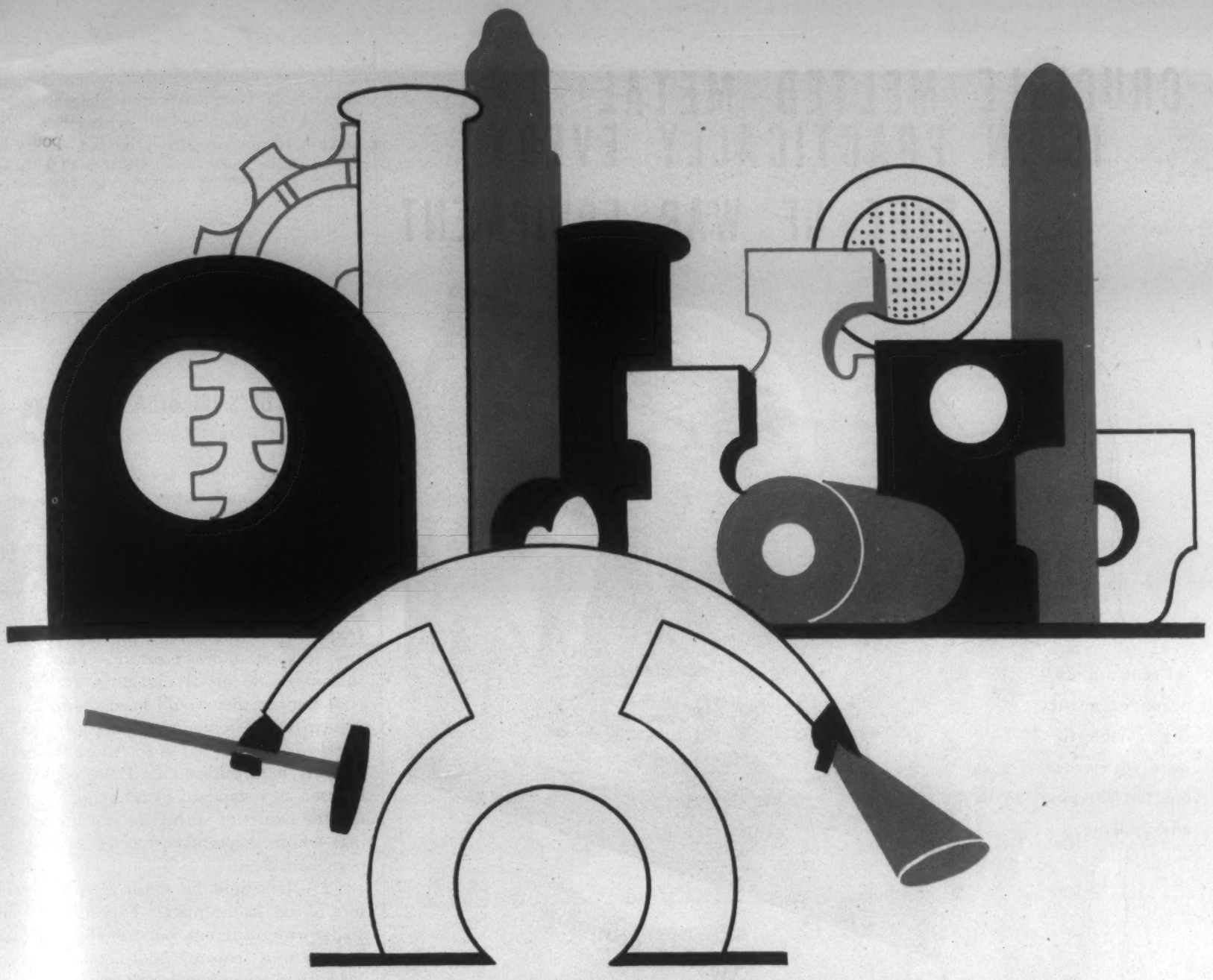
The problem of gating and feeding malleable iron castings involves the volume changes that occur as the molten metal is cooled to its solidification temperature and as the actual solidification process takes place.

If a particular section of a casting is to be sound after solidification, it must be able to draw molten metal from the adjoining section to compensate for these volume changes. Therefore, proper casting design and proper methods of gating and heading require that the matter of heat transfer within the mold, or rate of solidification, be given thoughtful consideration.

The time honored tool of the foundryman for controlling heat transfer is the chill. However, little information has been available concerning the quantitative effects of chills.

Data are reported on a number of solidification tests in which malleable iron castings were poured, held for various periods of time, and the remaining molten metal was dumped from the solidified shell.

Two pouring temperatures were employed, and solidification rates of malleable iron against five different types of sands and metallic chills of one-fourth in., one-half in. and three-fourths in. thickness was determined.



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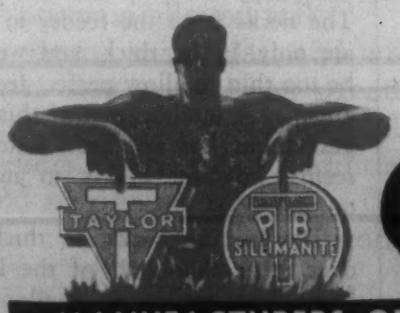

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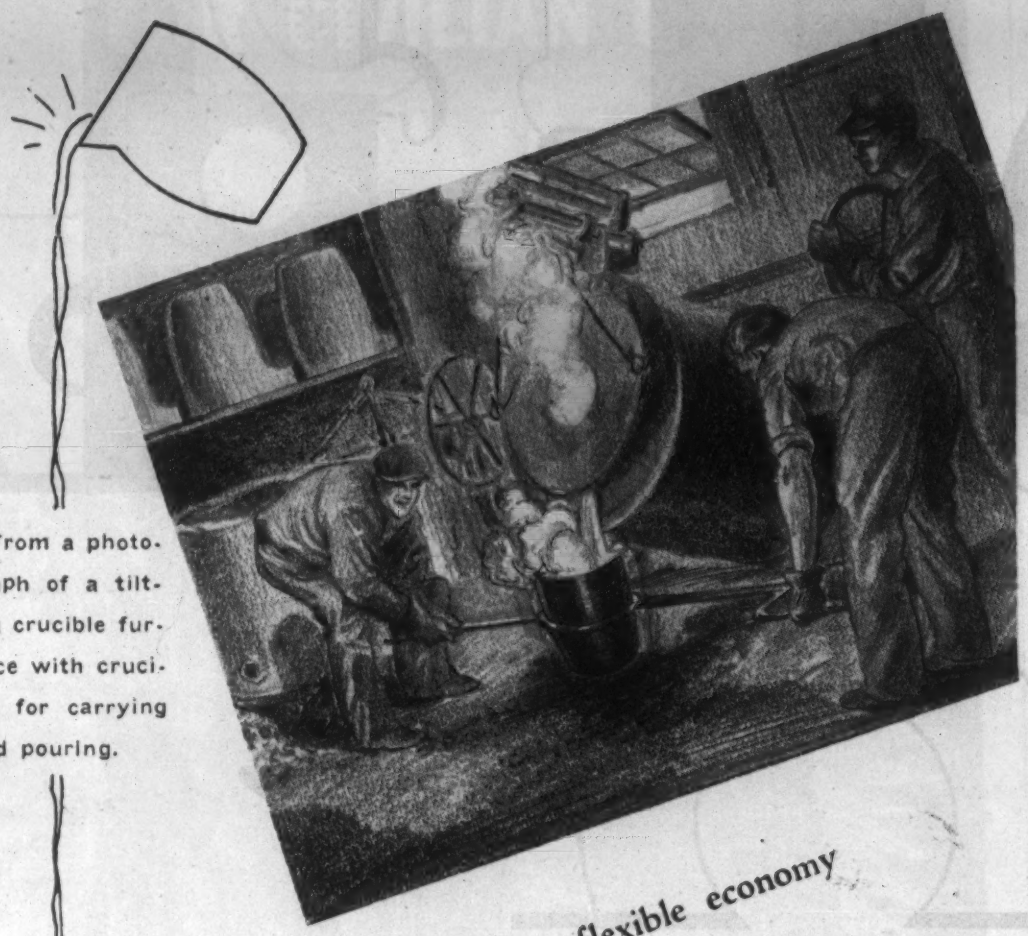

From a photograph of a tilting crucible furnace with crucible for carrying and pouring.

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The tanks, the ships of the sea and of the air, the jeeps, the trucks, all have in them metal that has been crucible melted. Wherever on any front a gun is fired, a bomb dropped, or a torpedo launched, crucible melted metal is back of it and in it.

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It was concluded that when freezing rates have been accurately determined, it should be possible to predict how any section of a casting may be fed.

—B. C. Yearly, R. P. Schaus & P. A. Martin. *Am. Foundrymen's Assn.*, Apr. 1944 meeting. Preprint No. 44-49, 16 pp.

Test Bars for Bronze Castings

Condensed from "Foundry Trade Journal"

A wide variety of test-bars is used in the copper-base and other non-ferrous alloy casting industry, with the result that test figures obtained in various foundries and laboratories are not strictly comparable.

It is known that the bronzes have very good casting characteristics, but porosity is frequently encountered, causing weakness and leakage under pressure. Two causes, shrinkage and dissolving gases, are known.

A test-bar that would meet the following principal requirements was needed: (1) It should be so well fed as to reduce shrinkage porosity to a minimum. These could then be used as a standard of reference for judging the effects of shrinkage and gas in castings whose shape makes perfect feeding extremely difficult.

(2) It should be sensitive to the pressure of gas in the metal. Experiments were made with different horizontally-cast bars. For various reasons, horizontal test-bars were then abandoned and extensive tests were made with the D.T.D. bar used universally by the light alloys industry, which, as earlier tests showed, gave very high-density bars from degassed material.

This bar has been used for the greater part of the Association's investigation on bronze castings. It has proved extremely satisfactory. The highest densities and best strengths are obtained using low pouring temperatures.

The D.T.D. test-bar has not been found satisfactory for the so-called high shrinkage alloys, namely manganese bronze and aluminum bronzes.

The most useful universal test-piece is likely to be a bar with some of the features of the Crown test-bar. In this bar a shaped specimen is fed through necks extending over the length of the specimen with the exception of the middle gage length portion, with a massive feeder over the length of the bar.

In its present form, the Crown bar is open to several criticisms. The feeder is narrow and deep, and only one bar is fed from it. The necks from the feeder to the test-piece are only ⅝ in. thick, and would probably be too thin to allow perfect feeding of some alloys. A modification of this bar was suggested but has not been tested as yet. It seems, however, likely to meet most requirements.

The feeding necks are thick and extend over more than half of the length of the bar. The feeder is shallow and thick, which makes for good feeding efficiency.

—W. A. Baker. *Foundry Trade J.*, Vol. 72, Feb. 24, 1944, pp. 155-160, 163.

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Dull Nickel Plating

Condensed from "The Monthly Review", American Electroplaters' Society

Several dull nickel baths recently developed show postwar possibilities. Development in bright nickel will probably be along the lines of improved organic brighteners and addition agents.

An improved hard nickel plating solution, recently developed by Wesley and Roehl, contains approximately 5 oz. per gal. of nickel metal as nickel sulfate, 4 oz. per gal. of ammonium chloride and 4 oz. per gal. of boric acid. It is operated at a pH from 5.5 to 5.9, temperatures from 120 to 140 F., and at current densities up to 100 amp. per sq. ft. The hardness varies with pH, temperature and c.d., and can be closely controlled.

Deposits with hardnesses as high as Rockwell C-50 and with fair ductility (3% elongation) can be obtained. The solution has fair throwing power, high cathode efficiency, and is well buffered.

A tendency to form nodular trees on sharp corners at high current densities can be avoided by operating at or below 50 amp. per sq. ft. A tendency to pit can be controlled with hydrogen peroxide or a wetting agent.

There are many applications for a bath of this type, one of the most obvious being for salvage and repair purposes. Where the abrasion and wear resistance required is not too severe, hard nickel deposits are as good if not better than chromium, and can be deposited much faster.

A disadvantage of electrodeposited hard nickel is its tendency to soften at elevated temperatures. Above 500 F., the deposits soften considerably. The amount of softening that occurs depends on both temperature and the length of time at the elevated temperature.

All-Chloride Bath

Another new bath is the all-chloride bath developed by Wesley. The solution contains 40 oz. per gal. of nickel chloride and 4 oz. per gal. of boric acid. It is operated at a pH of 1.0 to 5.0 and temperatures of 120 to 150 F. This bath has a very wide range of operating conditions.

Deposits with a dark velvet-like appearance are obtained at pH values from 3.0 to 5.0 and current densities of about 50 amp. per sq. ft. Lighter colored deposits are obtained as the pH is lowered, and semi-bright deposits are obtained at a pH of 1.0 to 2.0 and current densities of 75 amp. per sq. ft. and higher. All of these deposits buff easily to a bright finish.

Hardnesses are around 230 Vickers. The deposits are tougher and stronger than soft nickel deposits (Watts bath) and are more ductile than the hard nickel deposits, having about 15% elongation. The tensile strength of these deposits is approximately 100,000 p.s.i.

The solution has a very high conductivity, and can be used at high current densities. Sound deposits were obtained on an experimental scale at 3000 amp. per sq. ft. Anode and cathode efficiencies are high, even at the lower pH values. The solution is easy to control, and pitting is seldom encountered.

The principal disadvantage of the solution is its corrosive nature. Rubber-lined steel tanks, and Duriron pumps and heating equipment are satisfactory.

This type of bath has had little commercial application. The high current density possibilities suggests its use for high-speed plating of steel strip at the mills. Preplating of strip now being done with tin and zinc is likely to expand to include other metals, such as nickel, copper and lead.

A third type of bath, and one with which most are familiar, is the warm Watts bath, containing 40 oz. per gal. nickel sulfate, 6 oz. per gal. nickel chloride, and 4 oz. per gal. boric acid. It is operated either in the low pH range of 2.0 to 3.0 or the high range of 5.0 to 6.0, and at temperatures from 100 to 150 F.

Deposits made at a pH of 2.0, a current density of 50 amp. per sq. ft. and a temperature of 130 F. are very soft and ductile. The elongation is 30% in two in. This property makes the deposits particularly suitable for forming or stamping after plating.

The Watts bath has the advantage over the chloride bath of being less corrosive. It

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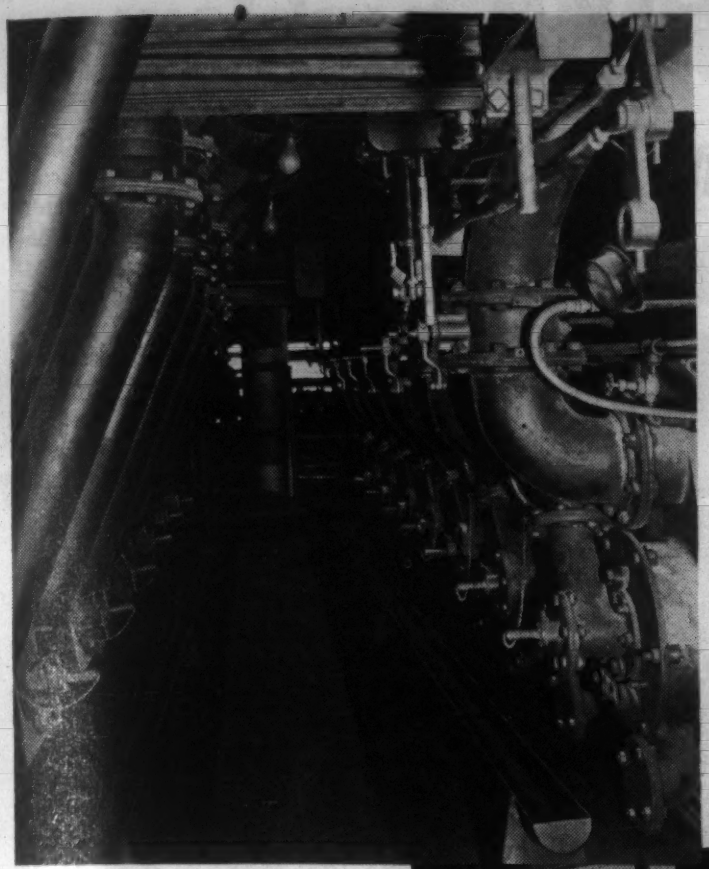

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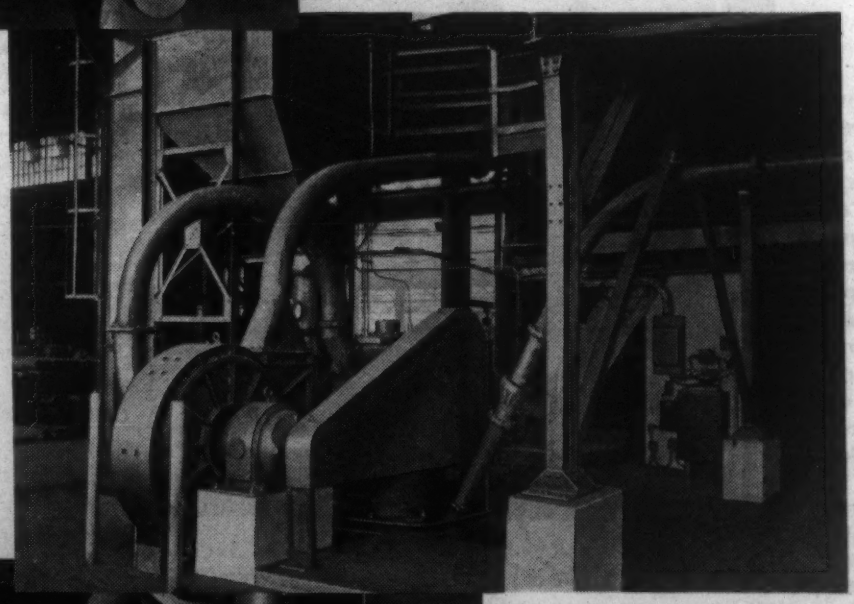
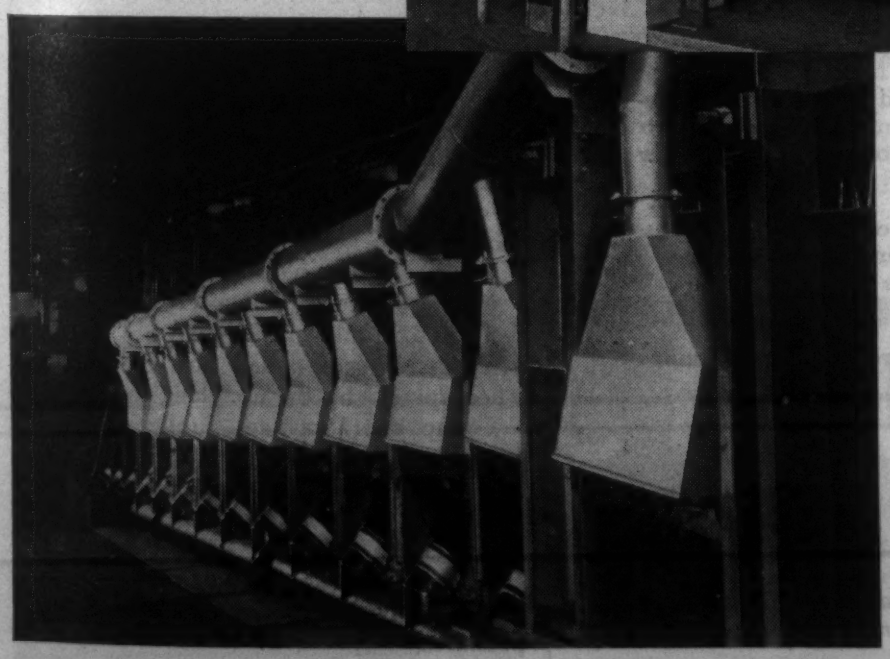


1 Multiple burner installation on single large furnace of double heating zone type. Burners at right firing heating zone and first group of burners in the circuit. Burners at left fire soaking zone and last group in the same circuit, which also serves a second large furnace of the double heating zone type.

2 The single, compact pulverizer unit can be conveniently located away from the furnaces, keeping floor space at furnaces clear for product-handling operations.



3 Hoods and ash sluicing systems eliminate dust nuisance ordinarily resulting from firing pulverized coal in heating furnaces with inadequate draft provision.

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Solving the Problem of Burring ALCAD SHEETS

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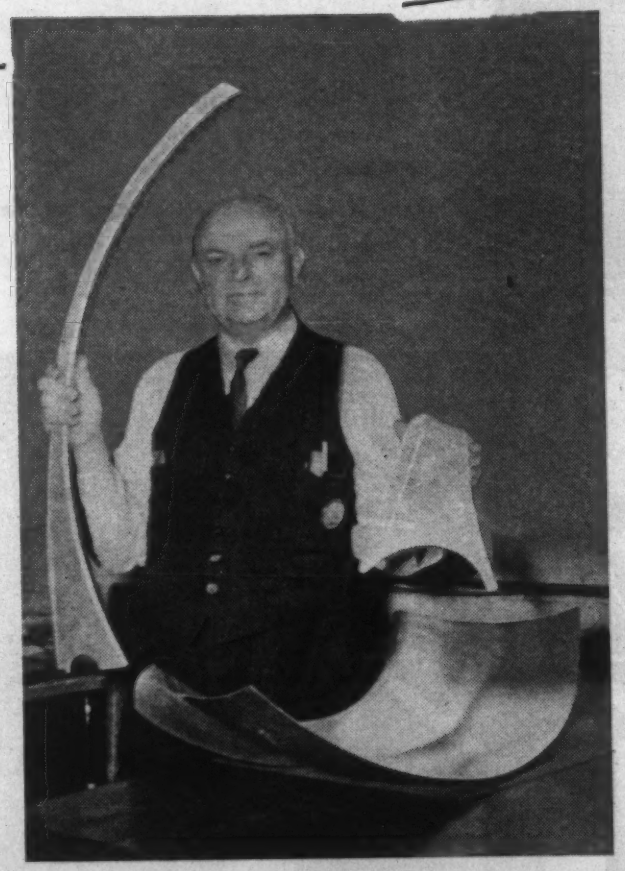


ARMY E NAVY

The American Stove Company, Cleveland, is carrying out important war contracts which include fabrication of plane parts from aluminum clad sheets. Upon assuming this contract, a high tempo of production had to be set and kept, but shifting from slow hand to faster machine burring and polishing of these ALCAD sheets presented some rather tricky problems.

ALCAD has a delicate film which can easily be damaged not only when being burred but in the washing afterwards. The resulting polish has to be such that it would not crack in subsequent forming operations. LEA Technicians were called in to advise on proper machine methods and to supply the proper compositions. How well they succeeded is summarized in this way by the management:

> **"From the production standpoint, we have gained considerably. The quality of work has been improved to such an extent that resulting scrap has been greatly reduced. We have been able to increase our production schedule."**

LEA serves industry by showing how to get faster, more economical, more precise burring, polishing and buffing.

THE LEA MANUFACTURING COMPANY

WATERBURY 86, CONN.

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods and Compositions

8-LM-3

is fairly easy to control, but is more subject to pitting and contamination by foreign matter than is the chloride bath.

—Thomas McFarlane. *Mo. Rev.*, Am. Electroplaters' Soc., Vol. 31, Apr. 1944, pp. 341-349.

Hard Facing

Condensed from "Welding Journal"

There are four common types of hard facing materials, which include those containing less than 20% alloying elements, those with more than 20% alloys, nonferrous alloys, and tungsten carbides. Hardness of the first three groups varies only 15 points on Rockwell C, yet for specific purposes one type may outlast the others by five to one.

In most hard facing materials, carbon ranges from 1 to 4½%. The primary purpose of the carbon is to convert as much of the chromium into carbides as possible and still maintain other desirable properties, such as wear resistance, weldability, ability to alloy in all proportions, etc.

Alloys in group one rely upon chromium to impart wear resistance. Aggregate alloys, including chromium, range from 7 to 15%. They are readily forgeable at high temperatures, but cannot be cold worked. They are subject to rapid oxidation at temperatures in excess of 500 F.

These alloys are used mostly for hard facing heavy equipment requiring the use of the electric method. They possess great resistance to impact, but do not have impact values comparable with S.A.E. 1050.

Alloys in group two have chromium as their wear-resistance base, varying from 18 to 35%. Aggregate alloys vary from 25 to 55%. An outstanding characteristic is their ability to polish in a high degree. They can be finished only by grinding, and cannot be worked or forged. Their resistance to wear is 10 to 15 times greater than S.A.E. 1050.

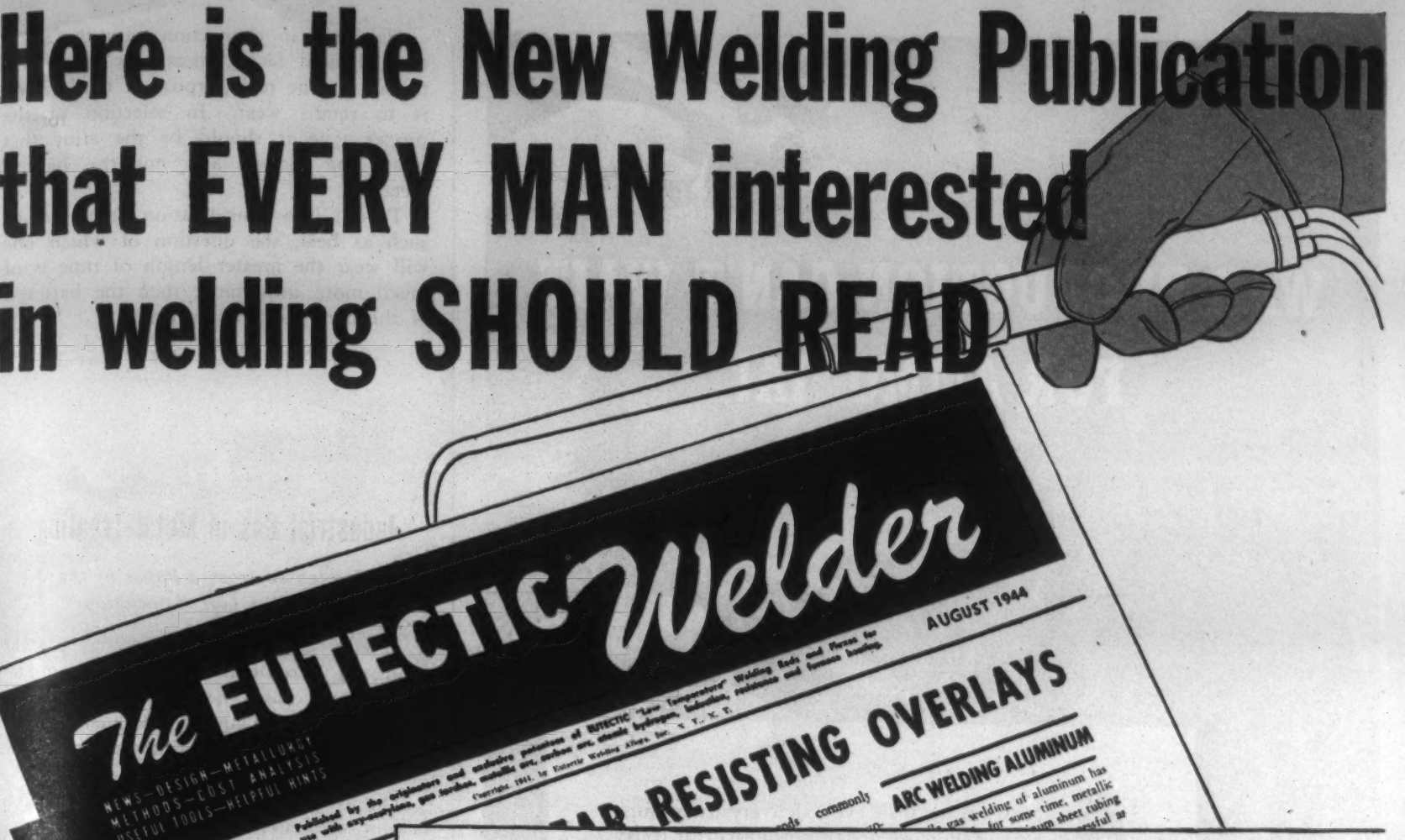
Group three contains little or no iron. Chromium ranges from 20 to 30%. Their corrosion resistance is superior to stainless steel.

Because these alloys are used where heat or corrosion are involved, they are produced in more than one type, the difference being in hardness and impact resistance. One alloy of this group shows a Rockwell C of 43, and is machinable with carbon tools. Another has a Rockwell C hardness of 54, being non-machinable.

Wear resistance of non-ferrous materials is 10 to 15 times greater than S.A.E. 1050. They have exceptional flowing qualities when applied by the acetylene method.

Group four includes tungsten carbide alloys. Tungsten carbide deposits can be heat treated, but are non-machinable. Finishing by grinding can be accomplished with diamond wheels. These alloys have a limited resistance to corrosion, and are susceptible to oxidation at elevated temperatures. Deposits have a wear resistance of about 30 to 1 over S.A.E. 1050. They are available for electric or acetylene application.

Here is the New Welding Publication that EVERY MAN interested in welding SHOULD READ



These features each month keep you posted on all developments and up-to-the-minute welding news

- ★ WELDING METALLURGY
- ★ WELDING DESIGN
- ★ PRODUCTION IDEAS
- ★ SALVAGING TOOLS
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- ★ USEFUL TRICKS AND TOOLS

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Hardness, in connection with the selection of hard facing metals, is of no importance. The real purpose of hard facing is to retard wear. In selection of the proper type it should be the alloy that wears the longest and not the hardest metal.

Taking into consideration other factors, such as heat, the question of which one will wear the greater length of time is of much more importance then the hardness of the hard facing alloy used.

—J. R. Spence. *Welding J.*, Vol. 23, Apr. 1944, pp. 318-321.

Industrial Gas in Metal Treating

Condensed from a Paper of the American Gas Association

In applying fuel gas technology to war production problems, equipment manufacturers have drawn heavily on prewar experience. Yet many developments have been carried through to create entirely new processes and products.

The availability of gas-fired radiant tube heating elements made possible some spectacular innovations in furnace design. The size of controlled atmosphere furnaces for heat treating was no longer limited by the practical size of heat-resisting alloy muffles. A series of duplicate furnaces for clean hardening armor plate sections 2 in. thick, 5 ft. wide, and 14 ft. long have an inside width of 6 ft. 3 in. and an inside length of 200 ft.

Gas carburizing was a process in general use before the war, but new carburizing atmospheres have been produced to permit more accurate control of case depth and carbon concentration.

An entirely new process for heat treating steel was bright gas quenching, developed for heat treating aircraft tubing. Jets of cold deoxidized gas are directed upon the work to obtain cooling rates formerly thought possible only by liquid quenching.

The serious effects of decarburization in heat treated steel are well known. It has been found possible to restore completely the carbon content of this weakened layer by heating in contact with an atmosphere in equilibrium with the desired carbon content. This "skin recovery" treatment is being used for springs to give them a maximum resistance to fatigue.

Spheroidizing Steel

Cycles used for spheroidizing annealing of high carbon steels are long. To prevent any surface change, either carburizing or decarburizing, during this long period of contact, special atmospheres, very low in concentration of active ingredients, have been developed. Careful removal of water vapor and carbon dioxide is the basic procedure.

Atmospheres consisting mostly of nitrogen with small percentages of carbon monoxide and hydrogen are prepared by combustion of an accurately proportioned air-gas mixture. Water vapor and carbon dioxide are then absorbed. This type of in-

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from the makers of **PENNSALT CLEANERS**

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• The first ship built in America, the "Virginia," was launched from the shores of the Kennebec in 1607. The Bath Iron Works Corporation is carrying on the tradition of the Kennebec today, launching destroyers like the one above. At its present rate of production, B.I.W. produces in one year more than twice as many of these ships as were launched by them during the entire World War I. Our hats are off to the men and women who have made possible this enviable record.

How fine these ships are is well expressed in the following extract from a letter written by the commanding officer of the destroyer pictured above:

"A word of praise for the grand job the Bath Iron Works did on the ship. She has been through h—l and high water and never failed us. Keep on building ships as fine as this . . . We have put on nearly one hundred and fifty thousand miles and she is as good as new."

We of Penn Salt are proud of the small part we are privileged to play in this outstanding achievement.

Galvanized work on these ships is first cleaned with a Pennsalt Cleaner to insure a finish which will withstand the extreme corrosive conditions of the sea.

Paint stripping is another important use of Pennsalt Cleaners at the B.I.W. In fact there is a Pennsalt Cleaner scientifically designed for nearly every type of metal and maintenance cleaning.

Our chemical engineers will be glad to demonstrate the benefits of Pennsalt Cleaners to you in your plant. No obligation. Write fully to our Special Chemicals Division, Dept. MA

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The extensive application of Rockwell Continuous Automatic Belt Conveyor Furnaces in heating processes has effected many remarkable improvements in product quality, production rate and operating economy. These Rockwell Furnaces—built to suit individual requirements—offer many definite advantages.

1—Automatic flow of material thru the heating and cooling (or quenching) cycles at any desired rate.

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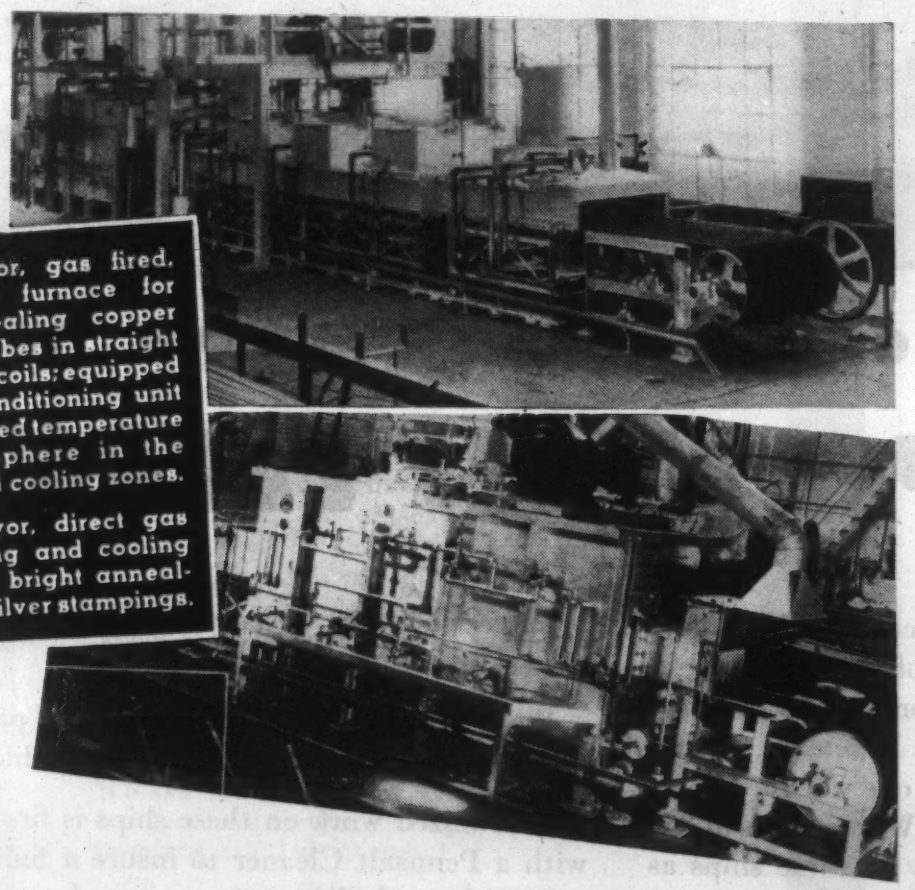
6—Capacity range from a few pounds to 10,000 lbs. and more per hour of ferrous or non-ferrous metal parts for clean or bright annealing, brazing, drawing or other heat treating.



Belt conveyor, gas fired, muffle type furnace for bright annealing copper and brass tubes in straight lengths and coils; equipped with gas conditioning unit and controlled temperature and atmosphere in the heating and cooling zones.

Belt conveyor, direct gas fired heating and cooling furnace for bright annealing nickel silver stampings.

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Write for Bulletin 378

CONSULTING SERVICE

In addition to the furnace engineering service, Rockwell offers a complete metallurgical consulting service, involving investigations and recommendations concerning the heating and cooling of metal products for uniform results.

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stallation can be used to prepare substantially pure nitrogen.

One of the most spectacular applications of controlled atmospheres has been to reduce or eliminate scale in heating steel for forging. Special forging furnaces using silicon carbide muffles have been constructed for this work.

Gas pickling, in which cold reduced steel strip is prepared to receive a very light and very adherent coating of zinc, was developed in time to play a part in war production. The steel strip is treated at red heat with a gas containing hydrogen chloride and little or no water vapor. A better zinc coating, more adherent and more resistant to fracture and spalling, results.

Flame impact heating, in which the flame of the burning gases impinges directly on the work, has been developed to give a higher rate of heating.

In the non-ferrous field, radiant tube heating of aluminum has permitted the heat-treatment of that metal without the burdening of already overloaded electrical installations. Bright annealing of copper and clean annealing of brass are now accomplished in direct fired, recirculating type furnaces.

—Carroll Cone. *Am. Gas Assn.* paper at the War Conference on Industrial Gas, Mar. 1944. 8 pp.

Welding Silver-Clad Steel

Condensed from "Welding Engineer"

The problem of combining the corrosion resistance of fine silver with the desirable physical characteristics of steel has been solved by the manufacture of silver-clad steel plate and sheet—quite similar to nickel-clad steel. A layer of fine silver is bonded to and rolled down with a base slab of steel.

The welding of silver and silver-clad steel gives rise to several unusual problems. The electrical and thermal conductivity of silver is such that its "hot short" characteristics may lead to cracking in the welds. It is also essential that all silver surfaces be thoroughly cleansed of grease and foreign matter before welding.

Silver welding problems can be overcome with skill and care. Silver melts at 1762 F., and is quite brittle near melting temperatures because of the element's tendency to absorb 22 times its volume of oxygen when melted. For this reason, it is desirable to preheat in order to insure silver cooling and to complete the expulsion of the absorbed oxygen.

On all silver welding it was found advisable to apply a preheat of 1000 F. to the entire section. The continuation of the preheat as welding progressed was also found necessary. The temperature was accurately checked by means of a pyrometer throughout the operation.

The silver welding rod was melted down without the use of a flux, which was avoided to prevent the introduction of impurities into the weld. The avoidance of a flux and the continuance of the preheat throughout the welding operation are probably the two

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A Proved Electrode For *high* Resistance to Impact, Abrasion and Wear

Harmomang is an electrode with the work-hardening qualities which suit it especially for the building up or hard surfacing of manganese and carbon steels.

It is a coated moly-manganese electrode with a hardness range up to 43-46 Rockwell "C". It can be used on AC, or for either straight or reverse polarity on DC.

Harmomang is the ideal electrode to use wherever you need protection against both impact and abrasion. For example: for hard surfacing dipper lips, dipper teeth, bucket runners, rock crushers, railway frogs or wherever longer life is desired for parts made of manganese or carbon steels.

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1000 & 1200

TWO NEW NON-DECARBURIZING
HEAT TREATING COMPOUNDS

Cyanamid research has developed and commercial use has proven these new materials. They are formulated to provide operating baths, without the use of rectifiers, for treatment of most grades of production and tool and die steels without decarburization. They can be used in all standard salt bath furnaces, either electrode type with metal or refractory linings or externally heated types using steel or alloy pots.

These new compounds provide baths which: do not increase in viscosity; reduce sludging to a minimum; permit a long pot and/or electrode life expectancy; prevent decarburization.

AEROHEAT 1200 is recommended for general use in the temperature range of 1325°F.-1550°F. AEROHEAT 1000 with a temperature range of 1125°F.-1700°F. is recommended only for use at temperatures not suitable for AEROHEAT 1200.

Physical Properties

	AEROHEAT 1000	AEROHEAT 1200
Melting Point	1020° F.	1225° F.
Specific Gravity at 1500° F.	136 lbs./cu. ft.	96 lbs./cu. ft.

Operating Characteristics

(note low-cost features)

1. Non-decarburizing
2. No rectifiers
3. A minimum of sludge
4. Low and unchanging viscosity
   (a) Low drag-out losses
   (b) Full quenching
5. Long pot and/or electrode life expectancy.

Make Cyanamid your headquarters for salt bath heat treating and carburizing compounds. Write for additional information on these new products as well as AEROCASE*, AEROCARB* and AEROCARB DEEPCASE Case Hardening and Carburizing Compounds.

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most outstanding peculiarities of a silver-clad welding job. As soon as the final silver had been deposited, the bead was peened while the temperature was maintained between 600 and 650 F.

Our experience indicates that it is desirable to limit the number of heating cycles to a minimum. Emphasis was placed, therefore, on the deposit of as much silver as possible during the first heat.

—A. Schwarz & W. B. Meyer. *Welding Engr.*, Vol. 29, May 1944, pp. 36-38.

Forging Armor Piercing Bombs

Condensed from "Steel Processing"

Stock for forging 1000-lb. semi-armor piercing bombs is received as commercial carbon-manganese seamless steel tubing, cut to length and bevel cut on the inside at one end. Bomb tubes are heated to 1800 F. in oil-fired forging furnaces, each accommodating two tubes simultaneously. Upset heat extends back 18 in. from the tube end. The work is in the charge five min.

An ogive compound circular curve is swaged from the straight tube and the nose thickness is built up by upsetting in a 2500-lb. all-welded double-frame, blacksmith-type steam-hammer. Thickness of the ogive is specified to uniformity at given points within a tolerance of $+\frac{1}{8}$ in., —0. Forging forms a small pigtail on the nose, which is greatly increased when the die gets out of line.

The tailing of the bomb is forged on a 2000-lb. double-frame, drop-forge steam-hammer. Dies are of case alloy steel and have $\frac{1}{2}$ in. clearance over finished dimensions of the tube.

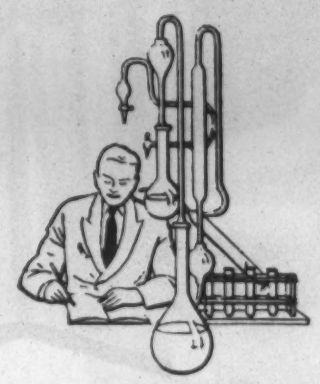
The work contacts on 120° of the die. The cover is 180°, 30° supplying relief on each side to prevent work from sticking. The tube is held to $\pm\frac{3}{8}$ in. in location of contour.

The tube is then cooled by a water spray to about 400 F., and three suspension lugs are tack welded on. The bomb is trimmed 1 to 5 in. by an acetylene torch, tolerance on overall length being $+\frac{3}{8}$ in., —0 at this point. A $1\frac{3}{8}$-in. hole is drilled through the nose on the bomb axis, a hanger is inserted, and the work is hung vertically on a trolley conveyor for heat treating.

Bombs are heated in an oil-fired normalizing furnace 20 by 8 by 8 ft. They are loaded into the furnace, two at a time, at a temperature of 1650 F. The soaking period is one hr. A pneumatic cylinder pushes the bombs through the furnace. Bombs at 1600 F. enter a water quench of not over 100 F.

Four salt pots, holding four bombs each, are used for drawing the bombs. The bath consists of sodium nitrite-nitrate at 900 to 950 F., and the cycle is one hr. Pots are fired by three oil-burners, set radially at the top.

After heat treating, lugs are tested by a steady hydraulic pull of 8000 lb. normal to the surface of the bomb, and a 3,500-lb. pull parallel to the surface.



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A complete line of wire, rod and bars

FIRTH-STERLING—a mill with a national reputation for consistently high quality Tool and Alloy Steels—is in a unique position to meet the special requirements of discriminating users of Stainless Steels. Since 1913, when FIRTH-STERLING made the first Stainless Steel produced in this country, we have specialized on made-to-order types for the most exacting specifications. Literature is available, giving complete details.

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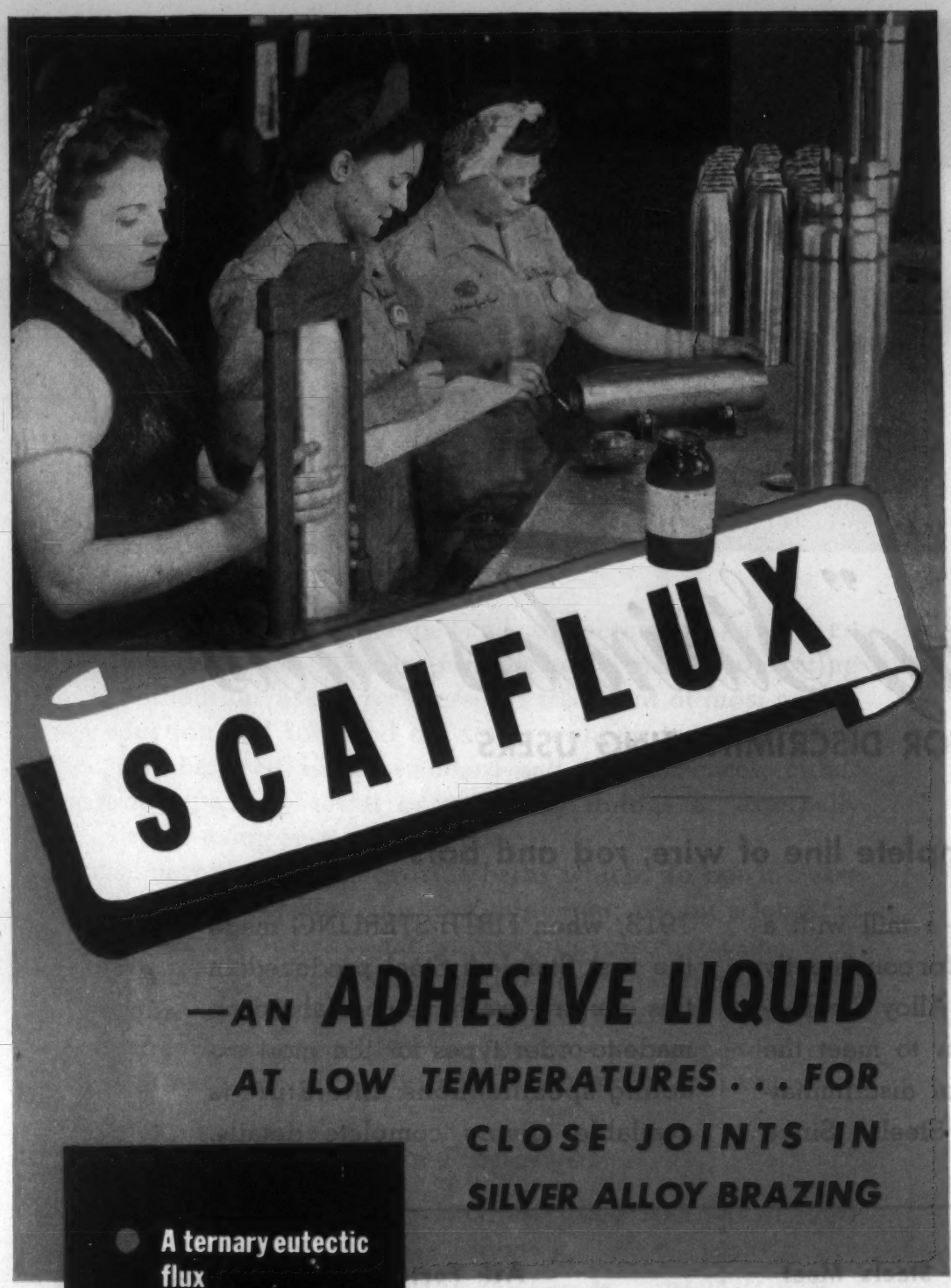

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SILVER ALLOY BRAZING

- A ternary eutectic flux
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- Low surface tension
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- Water soluble

Fine joining of close-tolerance parts becomes routine accomplishment in your silver alloy brazing, with SCAIFLUX! Because this modern flux paste becomes an *adhesive liquid* when preheated to 160° F.—*stays put* when brushed on metal surfaces —*flows readily* at low surface tension—has every characteristic required for consistent, quality brazing on today's exacting jobs. Write for Bulletin 316.

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The bomb is machined in four operations, X-rayed, degreased in a caustic bath, shot blasted, rinsed in a chromic-acid rust preventive, and paint sprayed.

—G. E. Stedman. *Steel Processing*, Vol. 30, May 1944, pp. 285-288, 324.

Silver Brazing Electrically

Condensed from "General Electric Review"

High-precision instruments must have well made joints between their copper lead-in wires and their resistance conductors. After adjustment and heat treatment, many coils are required to have a sustained accuracy of about 0.002 to 0.005%.

Resistance material used in these coils is manganin, and the copper-lead wires are butt-brazed to manganin winding. Most of the connection leads used in coils of low resistance are silver-brazed.

The method of silver-brazing consists of using a suitable heater wire that is connected in the secondary circuit of a low voltage transformer. A rheostat in the transformer primary adjusts the magnitude of the current flowing in the heater wire. The operator controls the duration of the current flow by means of a foot switch.

The sequence of operations is as follows: (1) Silver brazing flux made from evaporated liquid solution is touched to wire, and current is applied until bead is formed on loop. (2) Low-melting point (about 1200 F.) brazing alloy is used. A piece of alloy is picked up with tweezers and touched to heater wire. Foot switch is energized and the alloy melts.

(3) Foot switch is energized until alloy forms a small bead on the heater wire. (4) Lead and coil wires are joined and brought under bead of alloy, and foot switch energized. Wires are then removed from the heated zone. (5) Joint is cleaned in the usual manner.

As different sizes of wires are used, it is necessary to use various sized heaters in the secondary of the transformer. For butt-brazing of wires of 0.010 in. diam., ordinary copper wire of about 0.030 in. makes a good heater.

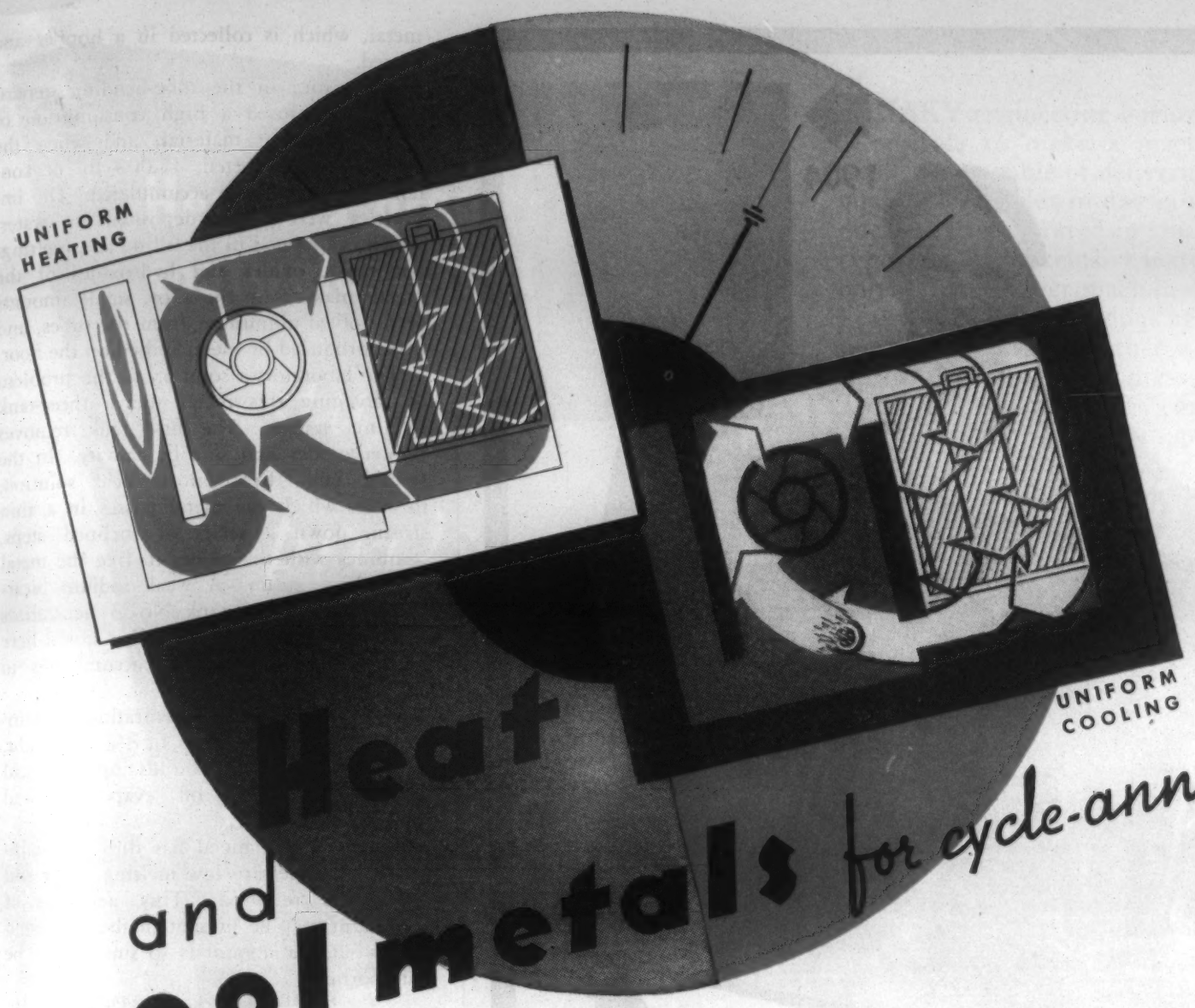
—Edwin G. Ryan, *Gen. Elec. Rev.*, Vol. 47, June 1944, pp. 40-41.

Reclaiming Wood's Metal

Condensed from "Aero Digest"

Methods for reclaiming contaminated Wood's metal, used in bending aircraft tubing, have been devised for use at Ford Motor Company's Willow Run plant. Considerable sums of money have been saved by reuse of the tube filler.

The metal tubing is filled with the low-melting alloy before bending, to prevent it from partially collapsing at the bend radius. After bending, the tubes are immersed in hot water to melt out the Wood's



Heat and cool metals for cycle-annealing

at precise temperatures with *fan driven* air!

Operating with fan driven air under terrific velocity from an isolated heat source, the Lindberg recirculating furnaces are able to do surprising things in the heat-treating field.

Because the heat source is outside the treating chamber, there is no radiant heat to distort outside pieces in the load, temperatures can be pre-arranged and an "automatic program control" set up for both heating and cooling without withdrawing the load from the furnace.

Cutting the heat source and continuing the fan allows quick and controlled cooling with the same exactness as the heating. Cycle-annealing, spheroidizing or isothermal transformation becomes simple and practical with the Super-Cyclone. In fact, every angle of heat treating shows an advantage with this remarkable furnace—it does work faster with a minimum of correction; it saves time, floorspace and manpower; it provides, in the same furnace, normalizing or annealing, hardening, or tempering. Write to Lindberg Engineering Company, 2451 West Hubbard Street, Chicago 12.

ARMY E NAVY

Lindberg FURNACES

SUPER-CYCLONE for hardening, normalizing, annealing, tempering

CYCLONE for accurate, low-cost tempering and nitriding

HYDRYZING for scale-free and decarb-free hardening

metal, which is collected in a hopper and reused.

Difficulties in the tube-bending department had caused a high consumption of the low-melting material, and when the trouble was corrected, 15,000 lb. of contaminated metal had accumulated. The impurities were: Salts deposited by water, which evaporated in the filling and melting-out tanks, oxides and hydroxides of the metals making up the alloy, small amounts of dissolved aluminum from the tubes, and dirt introduced by metal spilled on the floor.

The laboratory's solution to the problem of salvaging this metal was a three-tank refining system. The first tank removes lighter oxides and slag by gravity. In the second tank, hydrochloric acid solution, through which the metal passes in a thin stream down a series of inclined steps, combines with the oxides to free the metal and release steam. A weak sodium bicarbonate solution in tank No. 3 neutralizes remaining acid, and the metal is stored here until a sufficient quantity accumulates to cast into pigs.

Hydrochloric acid concentration is maintained at 20% by volume, or 8% by weight. When excess sludge builds up the acid solution is siphoned off, evaporated, and the salts recovered.

The reclaimed metal has thus far maintained the necessary low melting point and fine grain required. Tiny amounts of aluminum may be present in the reclaimed metal, but the amount is so small as to be unimportant.

—Franklin M. Reck. *Aero Digest*, Vol. 44, Mar. 1, 1944, pp. 103, 200.

Stud Welding

Condensed from "Industry and Welding"

A new welding gun is being used for pre-assembly of plastic armor systems in ships. In the Alabama Dry Dock & Ship Building Co., its use has reduced the man-hours needed to fabricate, assemble and install armor retaining systems on each ship from 540 to 89, and the linear feet of welding needed from 1773 to 288. In that company the studs are attached to the gun foundation and then bent at right angles to form supports for a coating of plastic armor.

On the West Coast, the plastic material is prefabricated in large blocks. Holes are drilled through and steel sheeting is placed on the outside and through the holes. This is placed in position on the bulkhead and the stud is shot through the hole. A nut and washer are put on to secure it.

A fibre bushing, which acts as an insulator, is removed each time and used over and over. The benefit of this type of insulation is that no hole is put through the bulkhead.

The operating principle of the stud welder is to create and control an arc between the stud and steel surface to which it is to be welded. The loaded gun is placed in position with the stud end and spacer legs against the plate. Pulling the trigger automatically completes the weld cycle. The

Here's a great small spotwelder that is

★ *sturdy...*

★ *precise...*

★ *fast...*

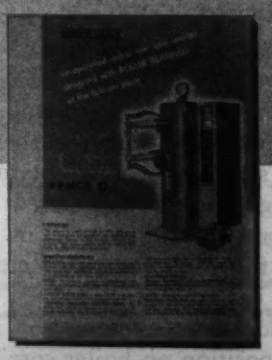
★ *compact...*

SCIAKY engineering has proved that it is possible to make a machine that is small, yet capable of delivering fast, high quality spot welds in day in and out production. Incorporated in this rocker arm type welder are exclusive features hitherto only used in larger machines. The use of heavy duty roller bearings at the fulcrum point of the arm, together with a special rubber cushion in the pressure cylinder, assure smooth action . . . eliminate hammering and wear. The design is compact with controls and contactor in a hinged cabinet . . . dials are convenient to operator and unit may be easily installed or moved.

If your problem involves the fabrication of mild, stainless or zinc-coated steels and brass in light gauges, it will pay you to consider the "PMCR.0-1."

MODEL PMCR.0-1

Rated 30 KVA at 50% duty cycle for power supply of 440 or 220 volts, 60, 50 or 25 cycles. Capacity: clean mild steel from two thicknesses of .016" up to and including .080"—stainless steel up to a maximum of .040" plus .040". Speed on two thicknesses of .032" thick pickled mild steel is 180 welds per minute. Maximum electrode pressure at 24" throat depth is 1000 lbs.



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In England: Sciaky Electric Welding Machines, Ltd., London

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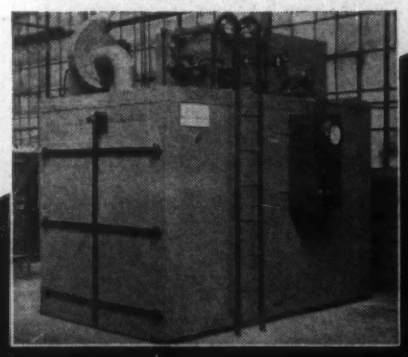
FURNACES and OVENS

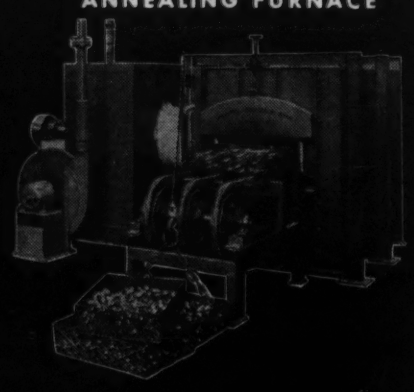
Regardless of the metal—the heating operation—or the size of the piece or the batch, you can depend on Morrison Engineered Furnaces and Ovens performing in a manner that will help you keep production promises. Years of experience back of every unit enables us to design for close temperature regulation, fuel economy, low maintenance and long trouble-free service life.

Morrison engineers are at your service. Talk with them before buying your next furnace, oven, rod baker or metal-coating equipment.



BOX TYPE OVEN

CONTINUOUS ANNEALING FURNACE



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CARRIER ENGINEERING CO., LTD. LONDON, ENGLAND

current is turned on, the stud is lifted to create an arc, which burns a predetermined length of time, and the stud end is plunged into the molten metal to complete the operation.

After-the-war applications are tremendous, as the welder may be used to secure all types of insulation material, plastic and wood decking, electric cable, light fixtures and switch boxes, to install portable steel scaffolds, railway maintenance, insulation and construction, boiler construction, manufacturing of automobiles, insulating and securing expanded metal lathe for stucco in home construction, and similar industrial uses where parts are affixed to metal.

—*Ind. & Welding*, Vol. 17, May 1944, pp. 46-47.

Arc Welding Airplane Boilers

Condensed from "Welding Journal"

In the DC-3 transports of United Airline, the tubes in the tubular factory boilers used for heating the cabins failed after about 100 hr. service, because of vibration. A stamped, gas-welded, corrugated boiler was designed, which was a decided improvement in cost and service. Corrugated boilers are now made by rolling and arc welding.

Core and outer shell blanks are rolled into tube form from the least expensive type of 18-8 stainless steel sheets, 0.05 in. thick. The core blank is clamped into a welding fixture with a copper backing plate to back up the weld and to dissipate heat.

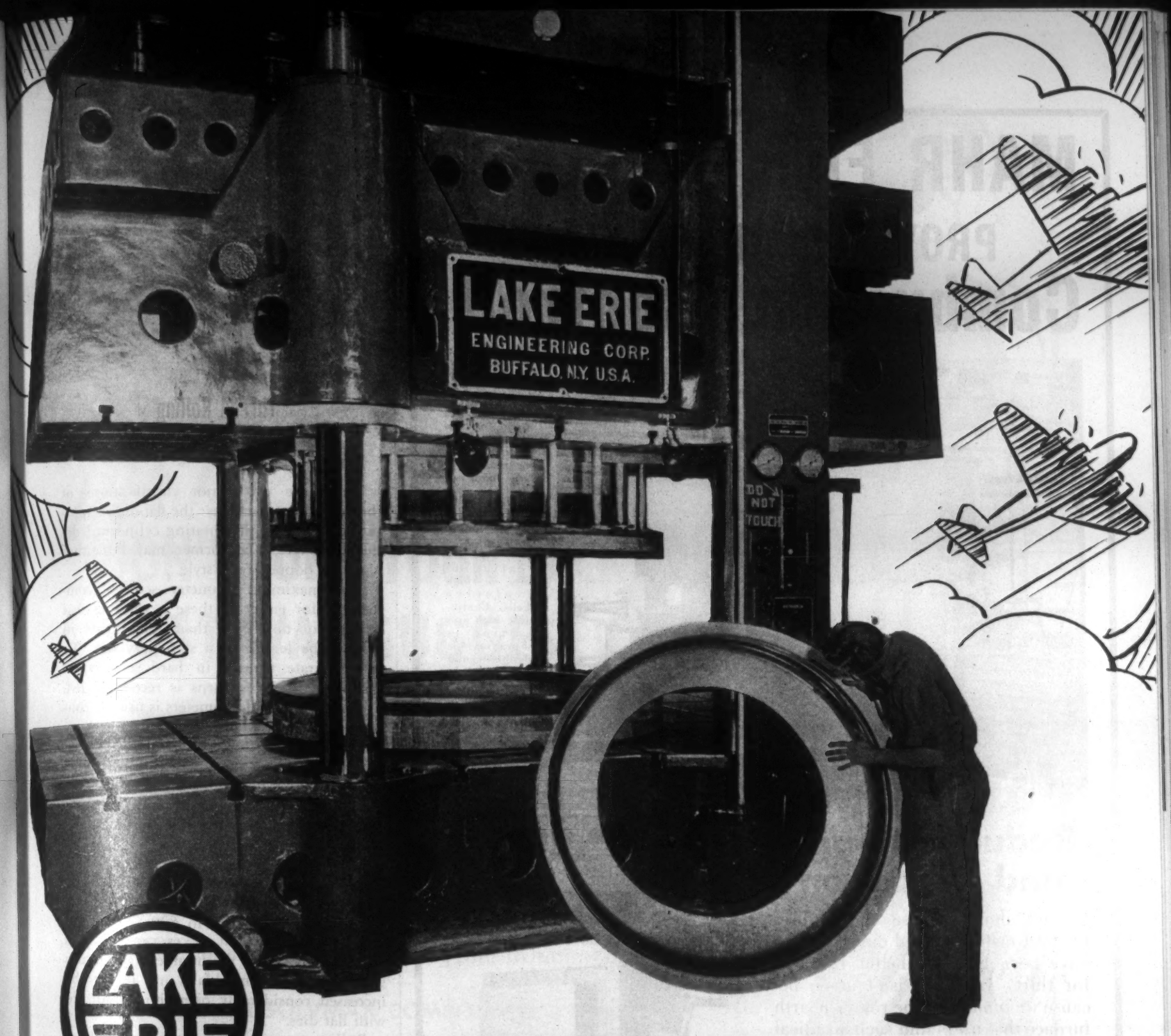
Tack welding is done in about a dozen places, and then a continuous weld is made. "Stainweld A" rod gives good penetration, and forms a ductile weld.

After removal of flux and some of the surplus weld, a light oil is put on the inside of the core blank, which is then placed on the corrugating roll. End plates held in position on the roll proper by set screws accurately locate the position of the first corrugation. After this has been formed, the end plates are removed, since each corrugation now being rolled is guided and spaced by the last preceding corrugation riding on the outer groove of the main roll. The standard depth of corrugation is ½ in.

The welded shell blank is slipped into position over the core, and the shell ends are arc welded to the core. The assembly is placed on the corrugating roll, and corrugations are rolled into the shell. Corrugations in shell and core must match, as the core is guided by the inner roll groves. Shell corrugations are 5/16 in. deep. During this forming, weld and metal are subjected to extreme pressures.

A welding jig is used for assembly in accurate position on boiler core and shell of steam and water sumps, steam outlet flange, water inlet fitting, and lugs for attaching the boiler to the aeroplane exhaust pipe.

After sand-blasting to remove all weld flux, the boiler is inspected. The steam outlet is plugged and an air-line is connected to the water inlet fitting. Under 110 lb. air pressure the boiler is submerged in water



LAKE ERIE

Whether your problem is to economically produce a variety of parts in limited quantities or continuous production at increased speeds with extreme accuracy, do it better with LAKE ERIE presses.

LAKE ERIE HYDRAULIC PRESSES have universal adaptability for every operation from deep drawing of large parts to shallow forming of small pieces using rubber pads with rapid changeover of dies. LAKE ERIE HYDRAULIC PRESSES should be investigated by the men who do the planning for your company's future.

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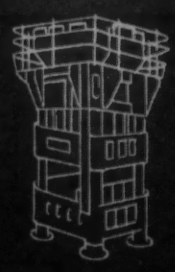
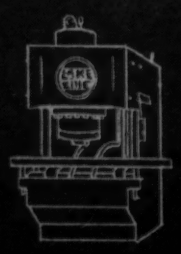
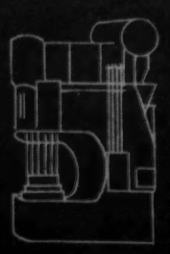
District representatives: 250 Park Avenue, New York 17, N. Y.; 230 North Michigan Avenue, Chicago 1, Illinois; Harron, Rickard and McCone, San Francisco and Los Angeles, California; Buck & Hickman, London, England.



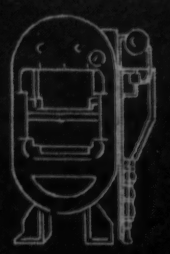
Single, double and triple action drawing and forming presses.



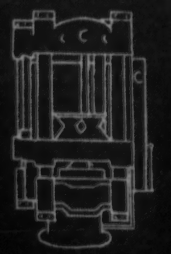
Accurate pressing control straightening presses.



Specially designed shipbuilding and plate bending presses.



Solid housing presses for heavy-pressure operations.



Presses for compression molded plastic products.

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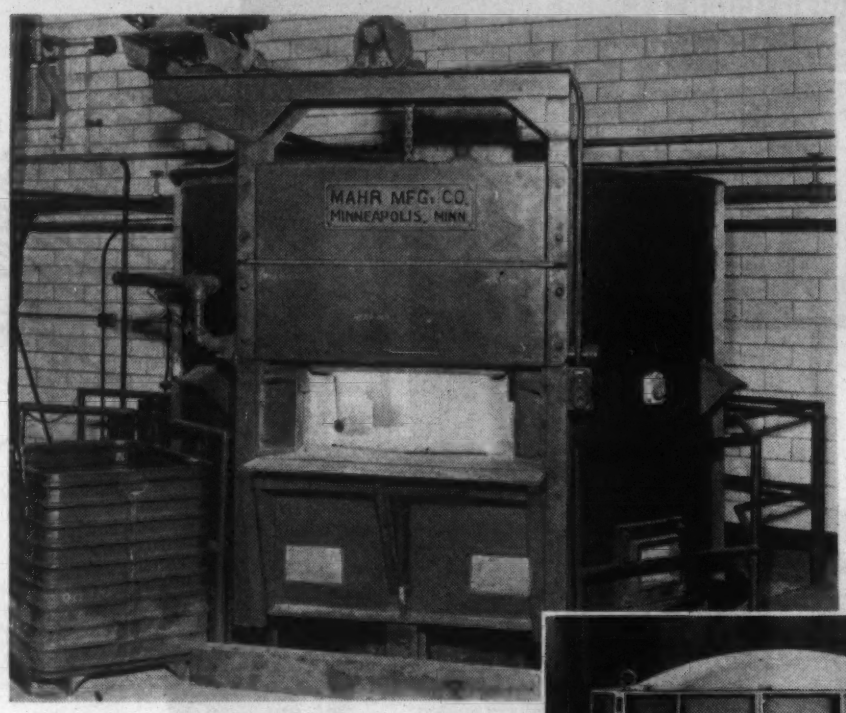
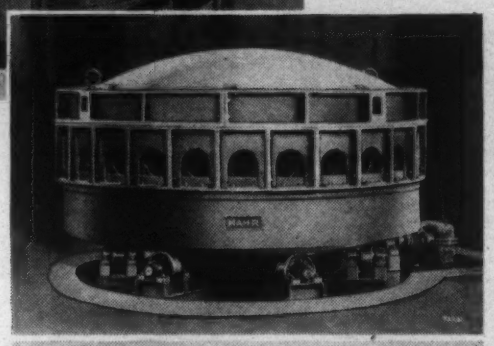
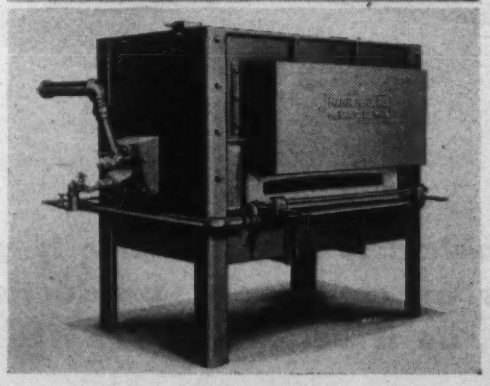
PROVIDES AUTOMATIC
Combustion Control!



(LEFT) MAHR Center Fired Rotary Hearth Furnace. One of a battery of these furnaces in the very modern forging plant of a large midwestern manufacturer.
(BELOW) MAHR Rotary Nosing Furnace used for heating the nose of high explosive shells. Continuous, high production is characteristic of this center fired rotary. In this furnace, however, the entire furnace rotates.





A modern MAHR Slot Type Stationary Forging Furnace. Fires toward and with arch from both sides. Illustrated and described in Bulletin No. 210.

Reduces Decarb and Oxidation

It isn't alone because MAHR uses the best materials, and our workmen have been building better furnaces for thirty years; it isn't alone because we *pioneered* the rotary hearth furnace that users find such a radical difference in the *quality* of forging billets heated in the MAHR center fired rotary.

It's the METHOD OF FIRING perfected by our engineers in this and other MAHR furnaces that accounts for the low percentage of decarb and oxidation. *Only* in the MAHR center fired rotary is combustion so nearly complete and harmful gases so thoroughly consumed before reaching the billets. That's because the flame goes directly upward to the arch, wipes the arch, then flows downward over the entire hearth area in a continuous, uniform volume nearly devoid of harmful effects. Burner adjustment is simple, because there is only one burner.

Ask for Bulletin No. 1000 on MAHR *center fired* Rotary Hearth Furnaces, or Bulletin No. 210 about other MAHR Forging Furnaces.

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for the detection of any pinholes. If any are found, they are welded and the boiler again tested under pressure.

This boiler weighs slightly under 15 lb., while most tubular-type boilers weigh about 30 lb.

—H. A. Lebert & S. B. Willoughby, *Welding J.*, Vol. 23, May 1944, pp. 434-437.

Thread Rolling

Condensed from "Screw Machine Engineering"

There are two major classifications of thread rolling machines: the flat-die reciprocating type, and the rotating cylindrical die thread roller. The former may be either hand or hopper feed style.

The maximum diameter screw recommended for either of these is the one that will make no fewer than four turns in rolling the length of a stationary die. To roll accurate threads in hard material, a minimum of seven turns is recommended. The range of blank diameters is usually confined from No. 0 to 1 in.

Operation of the cylindrical die thread roller depends on the action of a ball bearing oscillating head unit along which the die holder assembly is positioned. This unit forces the threading dies into the work and retracts them.

The threading capacity of the machine is from ¼ in. to 1 in. inclusive in diam. and in lengths up to 1½ in. It is capable of die speeds from 66 to 600 r.p.m., and feeds from 13 to 40 pieces per min. Its basic design allows the number of contracts between a point on a blank and a die to be increased considerably over those available with flat dies.

Rolling forms a screw thread by displacement of metal rather than removal or cutting. It is really cold forging. The cold working rearranges the internal structure in unbroken flow lines. It tends to increase tensile strength and shear strength. It produces a hard smooth burnished surface that increases fatigue resistance.

Accuracy of Rolled Threads

The accuracy of rolled threads is dependent upon the accuracy of the dies, the preciseness of the set-up, and the blank diameter. The latter is smaller than that of the finished screw, usually within a few thousandths of the pitch diameter, as the volume of the thread above the pitch diameter very nearly equals the volume of material displaced.

The smoothness of the rolled thread is conditioned mainly by the smoothness of the die. The range of materials that can be thread rolled is wide.

Some of the limitations of the process are: Only external threads can be rolled; in flat-die reciprocating machines it is not economical for small quantities; extra care is needed to prepare the blank properly; flat-die reciprocating machines are not suited to production of threads on most hollow blanks; threads shorter than one diam-

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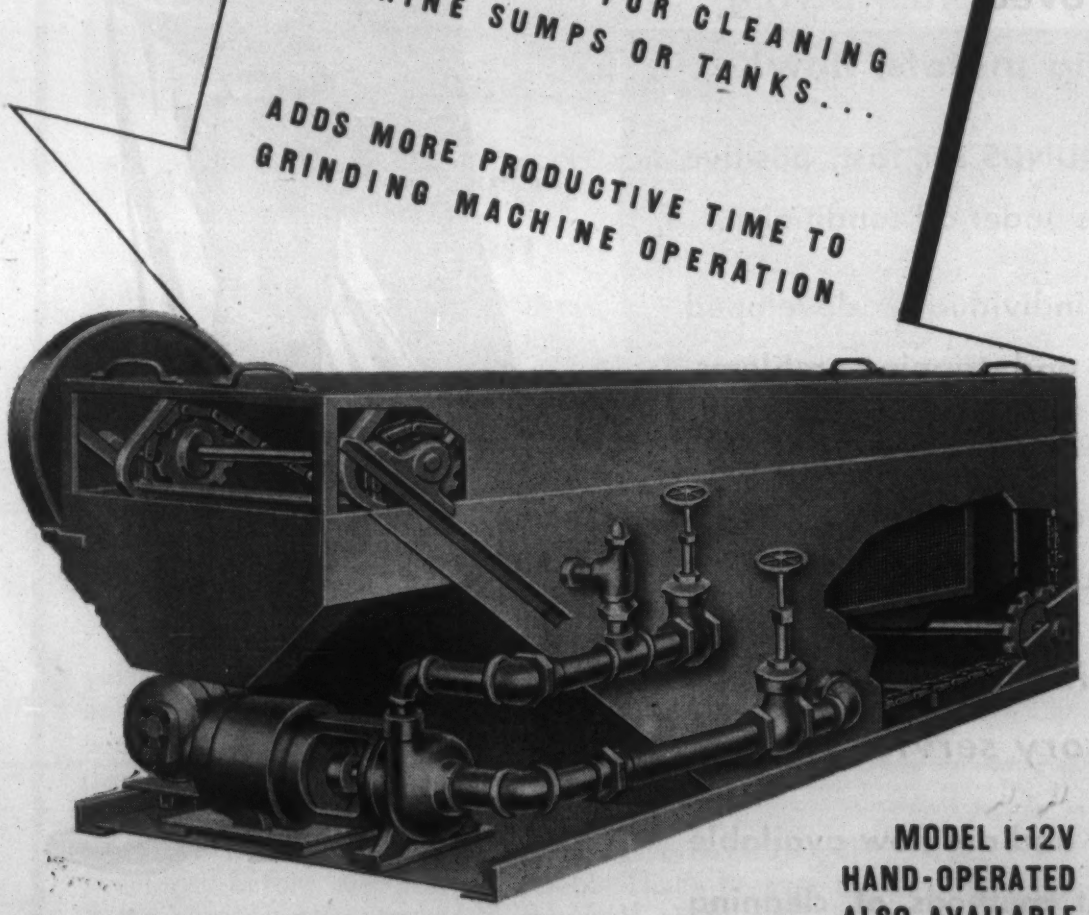
DELIVERS WASTE IN DRY FORM READY FOR EASY DISPOSAL...

AVOIDS DELAY FOR CLEANING MACHINE SUMPS OR TANKS...

ADDS MORE PRODUCTIVE TIME TO GRINDING MACHINE OPERATION



MODEL I-12V HAND-OPERATED ALSO AVAILABLE

HOFFMAN I-18V

Here is a truly revolutionary development in coolant conditioning—a new Hoffman coolant filter that cleans itself. Delivers 20 to 35 gallons per minute of effectively filtered soluble oil coolant used for heavy production on grinding machines. Motor driven scraper mechanism continuously removes the sludge in dry form. No shut-downs for sump cleaning.

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COOLANT FILTERS • FILTRATION ENGINEERING SERVICE

eter in length are difficult to keep straight in a flat-die reciprocating machine; rolling is not recommended for coarse pitch threads on blanks of small diameter and is seldom done in the cylindrical die machine on diameters of less than ¼ in.

Thread rolling offers the opportunity to take the "slow" threading operation off the automatics and leave them free to produce at shorter cycle times. The nature of part design will demand that many threads shall always be cut at the machine. With specifications permitting, threads will be cut indefinitely in cases where the rolling process does not indicate a clear margin of lowered cost over the cut method.

—*Screw Machine Engineering*, Vol. 5, Apr. 1944, pp. 34-38, 40-41.

Copper in Galvanizing Zincs

Condensed from "Wire and Wire Products"

Regardless of the text-book assumption that a pure zinc is desirable for galvanizing, small additions of other metals are sometimes very beneficial. For example, a small amount of antimony gives a pearly lustre to the spangles and also a galvanized finish that will stay brighter longer.

However, although the antimony addition is satisfactory for galvanizing metalware, such as buckets, it cannot be used for galvanizing strip as it makes the coating hard and brittle.

A small amount of copper, not over 0.25%, is believed to be actually advantageous to hot dip zinc coatings. Actually, even the extremely high quality "Remelt" zinc used for galvanizing may carry high amounts of lead, tin, copper and cadmium.

Zincs used for the past 14 years have contained: 0.40-1.24 Pb, 0.13-1.68 Sn, 0.004-0.32 Cu, 0.03-0.17 Fe and 0.06-0.38% Cd. All kinds of articles have been galvanized with no complaints of any kind in regard to the zinc coating for corrosion purposes and the usual uses for protection against rust.

The zinc is just one possible source of copper. Others are: use of muriatic acid dip that had been used to pickle copper, and addition of aluminum die castings containing copper to get the benefit of the aluminum content.

If the copper content is under 0.25%, it does not seem to have any outward effect on the appearance of the spangle or on the color of the zinc coating. Of course, harmful effects may be encountered when excessive amounts of copper or any impurity are present in the galvanizing bath.

The theory is advanced that the beneficial results of small copper additions and content of a zinc coating are the result of the formation of a zinc-copper top layer of the coating that is more resistant to corrosion than a pure zinc layer.

—W. G. Imhoff. *Wire & Wire Prod.*, Vol. 19, June 1944, pp. 353-357, 390.

ANNOUNCING

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Many alkali cleaners [illegible] oils, but hard-to-remove lubricants of the extreme pr[illegible] type require high detersive action [illegible] such as provided by Enthone Cleaner 100. ★ This remarkable new type alkali cleaner speedily de[illegible] the [illegible] ★ It successfully eliminates pre-cleaning. It works where other products fail.

Cleaner 100 is another result of [illegible] research by the Enthone Technical Staff that is going [illegible] ★ Read these reports.

CASE 484

Prominent electronics equipment manufacturer. Plating steel chassis. Cleaner required high current density to be effective. Corners of chassis where there was low current density not cleaned. Result: peeling of the plate. Changing to Cleaner 100 eliminated this trouble. Because of its high detersive action Enthone Cleaner 100 does not need high current density. This feature also accounts for its spreading preference as a soak cleaner as well as an electrolytic cleaner.

CASE 492

Leading manufacturer of totalizing machines. Pre-cleaning parts with trichlorethylene with a well-known brand name. After changing to Cleaner 100 reports: "Working beautifully . . . saves enough money by eliminating degreasing to pay for Cleaner 100 and make a profit to boot."

Order enough for convincing demonstration today . . . at our risk. Full instructions will come with the shipment.

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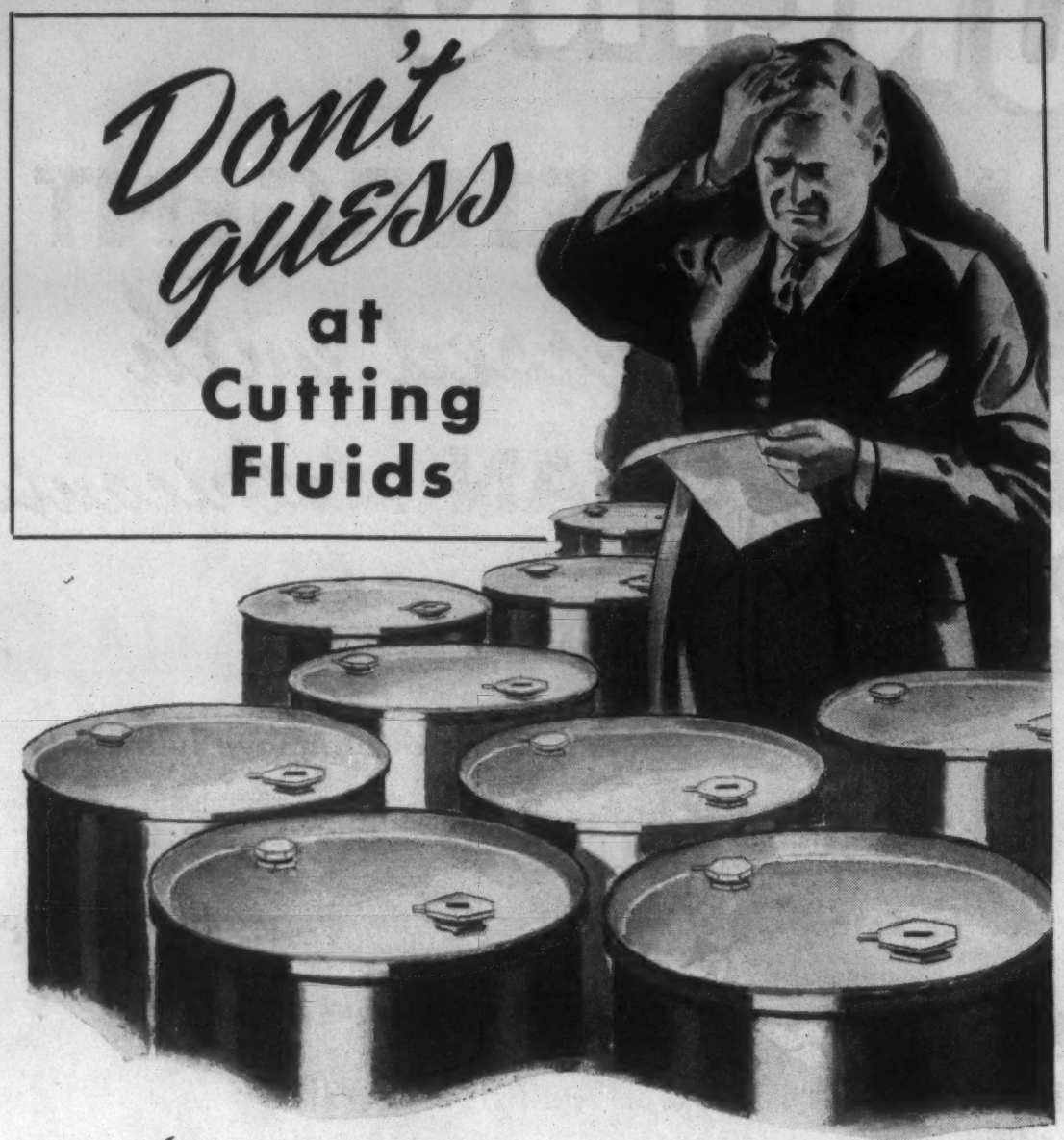
[illegible]E ENTHONE COMPANY [illegible] 448 Elm St., New Haven, Conn.

CLEANER 100

A MODERN [illegible] ALKALI CLEANER FOR STEEL



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Protecting Pre-Plated Metals

Condensed from "Metal Finishing"

Many manufacturing economies can be effected by the use of pre-plated steel for the making of stamped parts. Plating separate parts entails slower production and higher costs, which are eliminated when parts are stamped from pre-plated metal.

Pre-plated sheet can be obtained plated with nickel, nickel-chromium, copper, or brass, on selected steel in sheets or rolls. The material is available in a mirror finish, satin finish, and in striped designs and crimped patterns.

In order to fabricate articles from this material without defacing it, it is necessary that the surface be protected. A clear lacquer film, 0.001 in. thick, which is sprayed on after the plated strip comes from the polishing operation, performs this protective function.

This film remains intact, and gives complete protection to the highly finished surface from the time the sheets are unpacked, through high-speed stamping operations, to the time the finished part reaches its destination.

When it is desired to remove the lacquer film, it can be stripped intact by lifting an edge and peeling it off. Age, oil, and excessive drying do not deteriorate the lacquer film.

Peace-time products made from pre-plated sheet ranged from washing machines to popcorn poppers. Uncensored war-time uses include signaling mirrors, barracks mirrors, individual mirrors for service men, reflectors for running lights, etched data plates, and many parts for electronic equipment.

Many new peace-time uses are anticipated for this material after the war.

—Kenneth Main. *Metal Finishing*, Vol. 42, Apr. 1944, p. 252.

Roto Stretcher for Forming

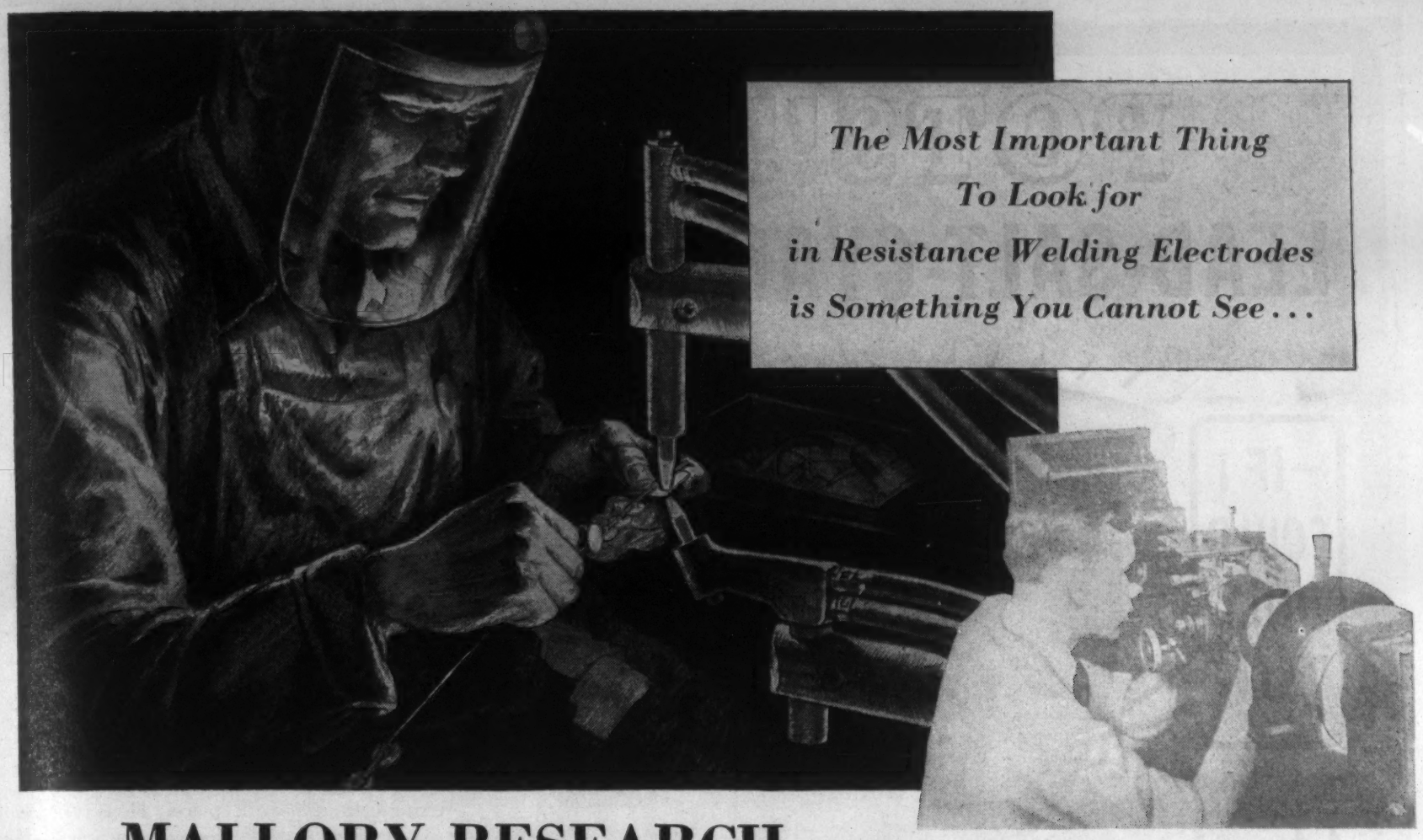
Condensed from "Modern Industrial Press"

A device called the roto-stretcher is used to form strips, extrusions and bent-up sections of metal of any cross sectional configuration into smooth contours of predetermined shape, stretching the stock material at the same time that the metal is wound around a forming die. The machine was developed by engineers of Goodyear Aircraft Corp., Akron, Ohio.

Due to the controlled force exerted during the entire operation, parts are formed without wrinkles. The machine in the Goodyear plant paid for itself during the first week. Only one man is needed to operate it.

The machine consists of a stationary base or table on which are mounted a revolving table and hydraulic cylinder. To the latter is attached a continuous chain that passes around a sprocket secured to the revolving table at one end and to an idler sprocket at the other.

As the table rotates, this cylinder moves forward or away from the turntable, depending upon the direction of rotation, at ex-



MALLORY RESEARCH . . .
The Invisible Element Behind Longer Tip Life

Finding the right resistance welding electrode for the job no longer necessitates slow and expensive "cut and try" methods. Mallory research, impersonal and thorough, greatly simplifies the task.

Mallory has had extensive experience in welding cold-rolled and stainless steels, aluminum and magnesium alloys, nickel steel, plated metals and many other combinations of similar or dissimilar materials. Mallory has developed a large number of electrode materials which, separately or in combination, provide the correct alloy and the most efficient design for almost every need. And it can place in your hands enormously helpful data on heat, pressure and timing requirements in joining special metals.

No matter how advanced your ideas for improving products or methods, Mallory research is ready to help you. It is the intangible plus-factor behind longer electrode life and sounder, cleaner welds in the quickest possible time. It can give you, as it has already given to many others, better, speedier production at less cost.

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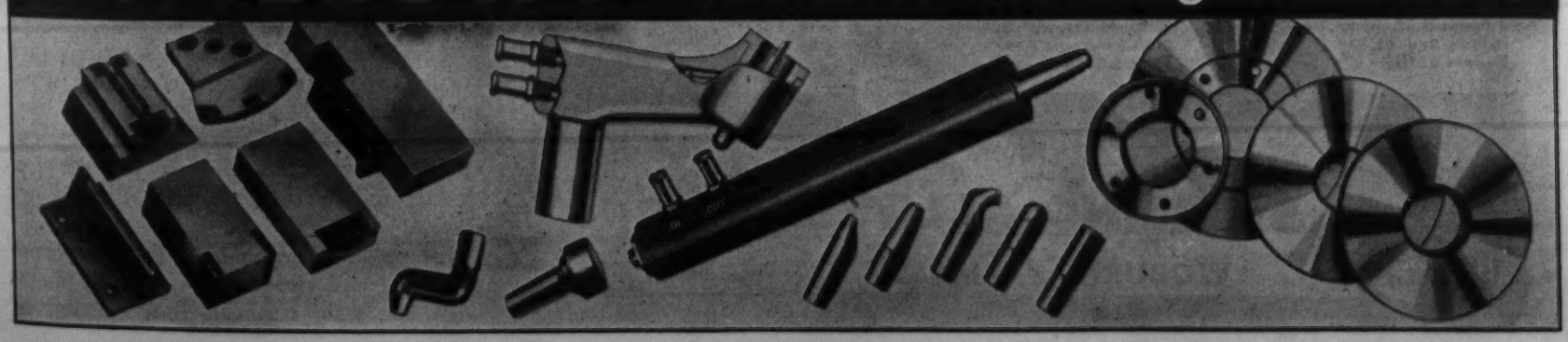
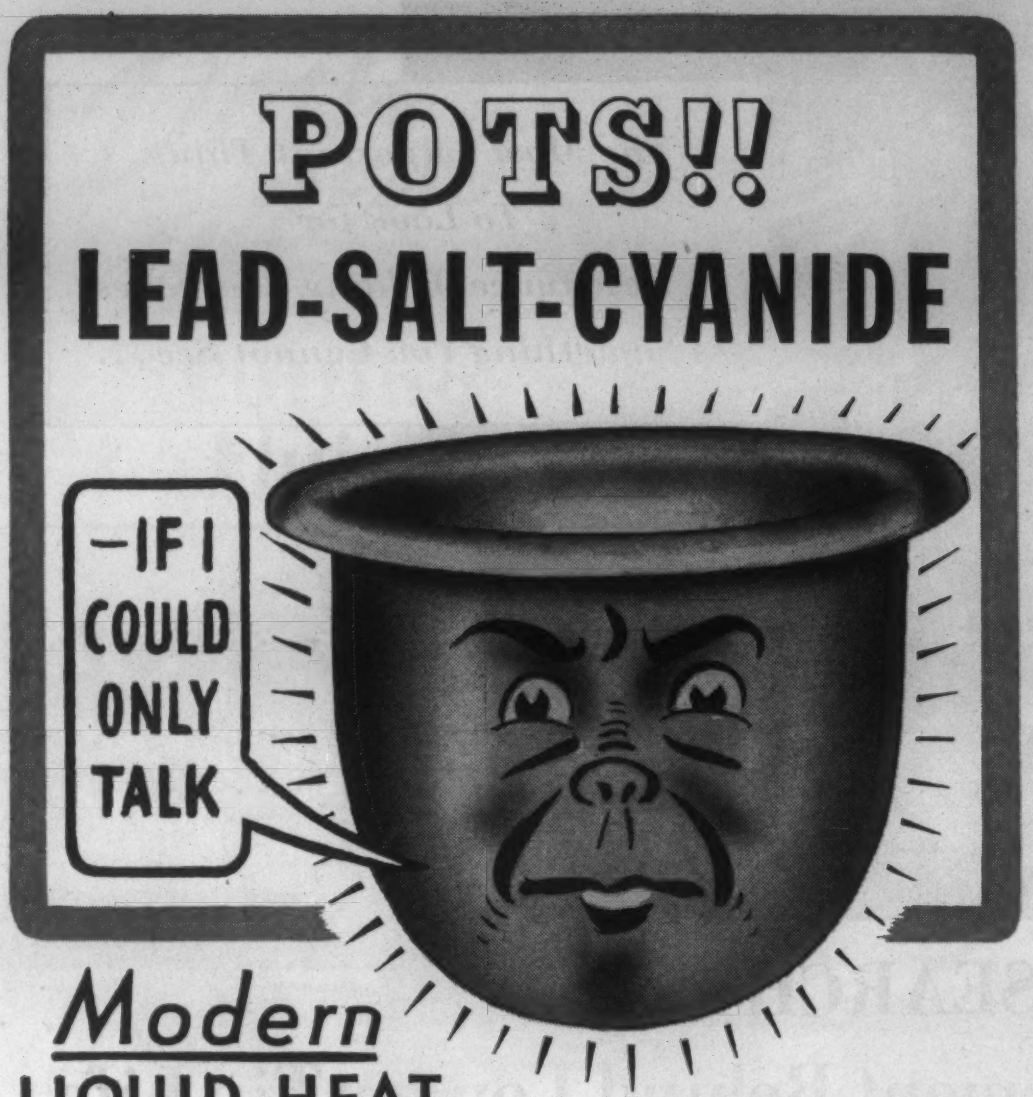
MALLORY *Standardized Resistance Welding Electrodes*





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actly the same lineal speed as the periphery of the sprocket. The stock is held by two pneumatically-operated jaws, one fastened to the piston rod of the cylinder and the other clamped to the revolving table. Controlled tensile force is exerted by the assembly, particularly by the hydraulic control.

One can stretch-form contours up to 360° and springback of parts is negligible. The table makes a complete cycle in 45 sec. The roto-stretcher has a pulling capacity of 15 tons.

Usually the maximum length of the part to be formed is 72 in., but with a certain clamping arrangement the length is practically unlimited.

Usually form blocks are fastened on standard clamping blocks on the revolving table with two studs, the arrangement preventing springback. Two forming operations are usually done, but if the contour is to be slight, one may be sufficient. Where two operations are performed, a heat-treatment is given after the first operation.

The circumferential speed of the form block usually differs from the speed with which the hydraulic cylinder approaches the turntable. This difference is compensated for by the movement of the piston in its cylinder in maintaining the pre-determined tension in the work piece. However, the tension in the work piece can be increased or decreased during the forming operation.

—*Modern Industrial Press*, Vol. 6, May 1944, pp. 28-30.

Phosphate Coatings

Condensed from the "Journal of the Electrodepositors' Technical Society"

The development of phosphate coatings for iron, steel and zinc is traced from the year 1849. The process, known as Parkerizing, has had wide adoption since 1915.

The coating produced by this process is a relatively thick phosphate coating, which, when sealed by a suitable medium such as oil, has sufficient corrosion resistance for many applications, such as nuts, bolts, parts of typewriters, etc. In 1930 the process known as Bonderizing, which produces a thinner phosphate coating suitable as a base for paint, was introduced. The treatment time of 10 min. permitted the use of conveyorized equipment.

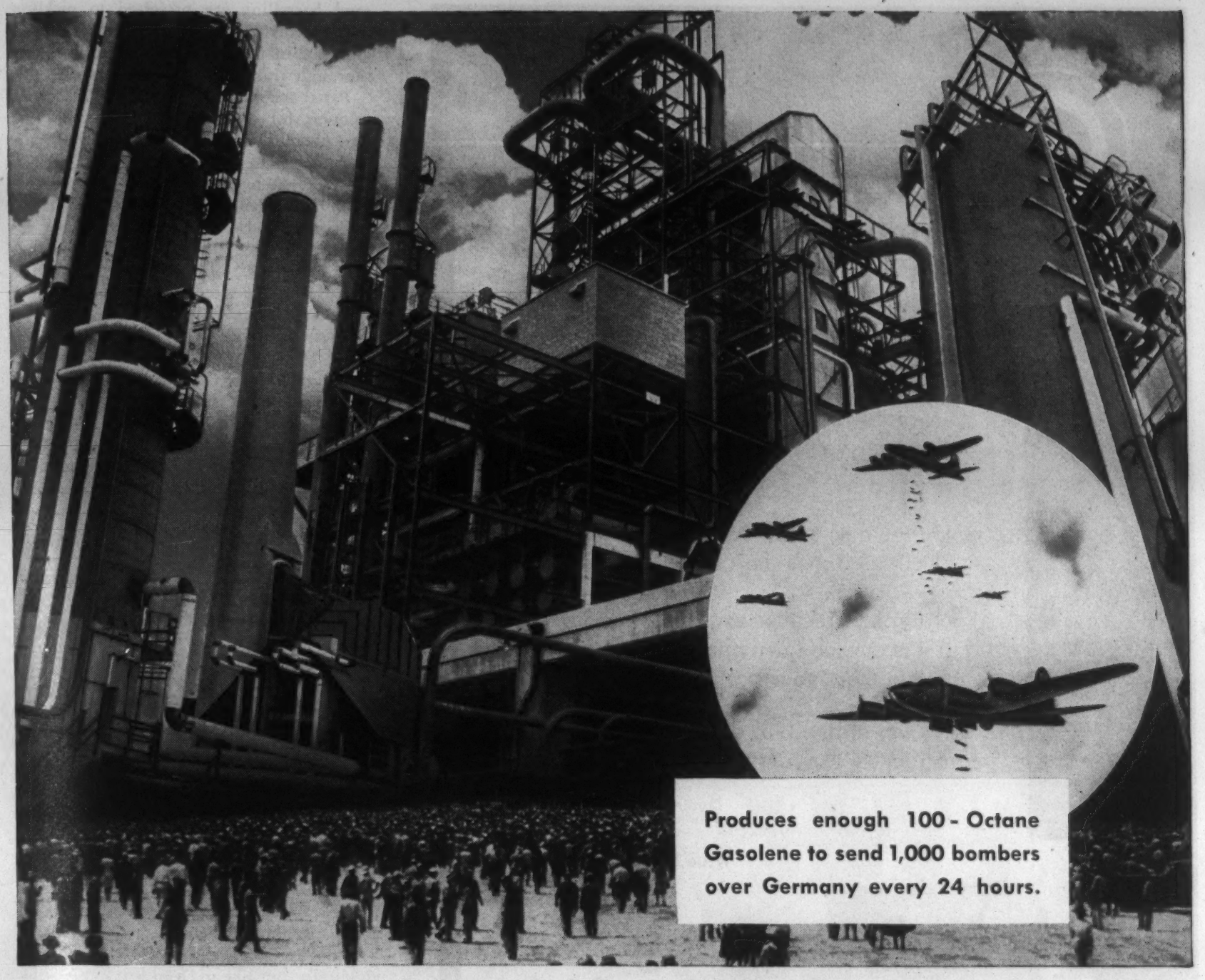
During the past 12 years, progress has been made in three main lines:

(1) *Speed of Processing.* Accelerators reduce tank Bonderizing time to 5 min. In the Spra-Bonderizing process, in which the solution is sprayed onto the parts to be treated, the processing time is less than 60 sec.

(2) *Quality of Coating.* Solutions give coatings of more uniform crystalline structure.

(3) *Ease of Operating.* Solutions operate at lower temperature, produce less sludge, and have greater flexibility of operation.

In applying phosphate coatings, parts are degreased and cleaned by customary methods. For scale removal, shot blasting or



Produces enough 100-Octane Gasolene to send 1,000 bombers over Germany every 24 hours.

CITIES SERVICE

dedicates one of the world's largest 100-Octane and Butadiene Plants

WITH THIS giant plant at Lake Charles, Louisiana, Cities Service, in cooperation with the Government, takes a tremendous stride toward meeting two most vital war needs.

Sired by the necessity of War, the plant means more power to the armed forces, for it turns out great quantities of high-octane aviation gasolene and ingredients for synthetic rubber.

Created from the ground up, it includes the very latest discoveries and inventions; and it is wholly dedicated to bringing the War to an earlier close. This great accomplishment is an outstanding example of what can be achieved by the winning team of Government and Industry . . . working together, shoulder to shoulder, in the battle for Freedom and Peace.

GASOLENE POWERS THE ATTACK—*Don't waste a drop!*

✓CHECK LIST OF OUTSTANDING FACTS . . .

1. The Refinery produces enough 100-Octane Gasolene to send 1,000 bombers over Germany every 24 hours.
2. Ten per cent of the Nation's normal rubber demands will be supplied by the Government-owned Butadiene Plant, operated by Cities Service, and the Government-owned rubber plant, operated by Firestone.
3. The Refinery alone covers 600 acres.
4. Powered by enough electricity to light a city of 250,000.
5. 275,000 gallons of water per minute are pumped into the refinery.
6. 25,000,000 man-hours went into its construction.

CITIES SERVICE OILS — ONCE-ALWAYS

FREE: Handsomely illustrated booklet about one of the War's biggest industrial achievements. Write Cities Service, Sixty Wall Tower, New York 5, N. Y.

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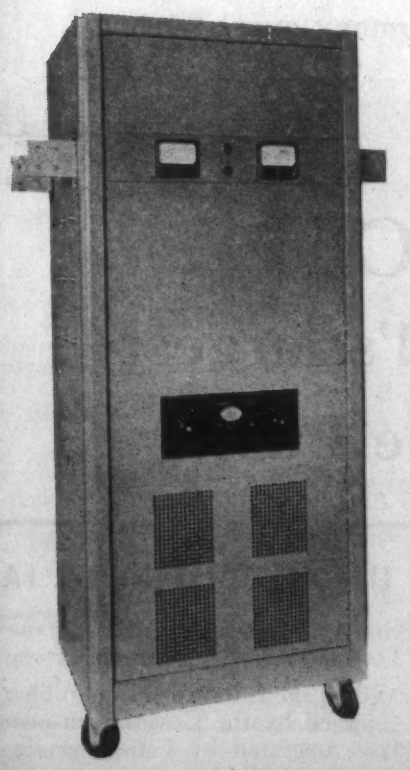

To attract your attention we use this picture of a large rectifier. But we also make small ones, either Selenium disc or tube. The size is always determined by design requirements.

30 watts to 30 kilowatts.
6 volts to 10,000 volts.
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RECTIFIER ENGINEERS

EST. 1893

sand barrelling are preferred to pickling. Trichlorethylene degreasing, or alkaline cleaning in a spray machine, followed by thorough rinsing, is standard practice.

Parts are immersed in the Parkerizing solution for a time that varies with the type of solution. The time range is 10 min. to 1 hr. at a temp. from 175 to 212 F. Parts are then rinsed thoroughly with hot water and dried in a heated oven, a heated centrifuge, or by compressed air. They are then finished by one of the methods already mentioned, *e.g.*, oiling or painting. If a black finish is desired, a water soluble black dye may be applied.

These methods of rust-proofing have found their greatest use in the production of automobiles, refrigerators, etc. In addition to these uses, phosphate coatings are used to replace tin for canning and packaging, to facilitate deep drawing and prevent excessive wear on dies, to provide an oil-retaining coating on surfaces that are subject to wear by friction, and to serve as an electrically insulating coating.

—R. C. Davies & S. J. Scouse.
J. Electrodepositors' Tech. Soc.,
Vol. 19, 1943, pp. 13-22.

Electrocleaning of Steel

Condensed from "The Monthly Review," American Electroplaters' Society

The evidence for electrocleaning of steel, in the writer's opinion, is greatly in favor of anodic cleaning. The fact that there is twice as great a volume of gas (hydrogen) formed at the cathode as gas (oxygen) formed at the anode has little bearing on actual cleaning efficiency.

However, platers seldom clean purely anodically, but like to clean first cathodically and then anodically, using a double-throw switch.

In regard to the alkalis used, the cationic portions are almost always the same, namely sodium. This means the sodium ion migrates toward the cathode with a sodium ion concentration at the cathode interface not greatly different regardless of what alkali has been used, *e.g.* sodium carbonate, hydroxide, or silicates.

On the other hand, the negative portion of alkali cleaners is anionic and tends to migrate toward the anode. We would expect, therefore, greater variations in cleaning efficiency with different alkalis when anodic cleaning is done. The detersive effects of phosphate, pyrophosphate, metasilicate and hydroxyl ions would be different.

Likewise, most surface active materials, "wetting agents" and soaps ionize in such a manner that the organic portion of the wetting agent is anionic. Most cationic wetting agents are not stable or effective in alkaline solutions. Good surface tension lowering is no criterion for good cleaning.

Most alkali cleaners contain complex phosphates and caustic soda, which are able to dissolve small amounts of metals in the cleaning solution. It has been observed that metals, such as iron, tin, zinc, lead and copper, will deposit out of a contaminated cleaning solution when the work is the

3 MEN

DO THE WORK OF 50

WHEN DIVERSEY PROCESS IS USED TO PREPARE ALUMINUM

FOR SPOT WELDING

HELP WANTED!

Here's one "help wanted" problem that's easily solved . . . even in these days of man-power shortages. If it's a problem in metal cleaning and working . . . the Diversey D-Man is always on deck to lend a helping hand. Backed by a Research Laboratory that has spent 18 years developing special purpose products, the Diversey D-Man can often show you ways to step-up production that require less manpower.

DIVERSEY D-MAN

Here's a true story of what happened recently in one plant: Prior to adopting Diversey products for preparing aluminum for spot welding, over 50 people wire-brushed the work to remove oxide film. Today, with the Diversey Process, only 3 men are needed for the job. While using the scratch brush method, this plant averaged 3,500,000 spots per month. Today, this output has jumped to 7,000,000 . . . an increase of 100%. About 400 to 600 high quality spot welds are averaged between tip cleaning operations.

The Diversey Process involves two simple steps:

1. Removing all foreign matter from the surface with Diversey Aluminum Cleaner, a dry, white powder, easily used in still tank cleaning, whose powerful cleaning action is inhibited to prevent pitting, staining or discolorations.

2. Eliminating the oxide film with Diversey D-C No. 1, a non-toxic, non-fuming powder developed to replace harsh, corrosive, dangerous acids.

It has been definitely established that the production of consistently sound spot welds is, in part, a function of the surface treatment. Aluminum treated by the Diversey Process shows no "water breaks," indicating a chemically clean surface . . . while surface resistances average as low as 12 microhms.

Today the Diversey Process is in use in many large aircraft and other plants throughout the country . . . consistently giving quality spot welds with greatly increased tip life. For further details send for free technical bulletin No. 501. Address Metal Industries Dept. W4.

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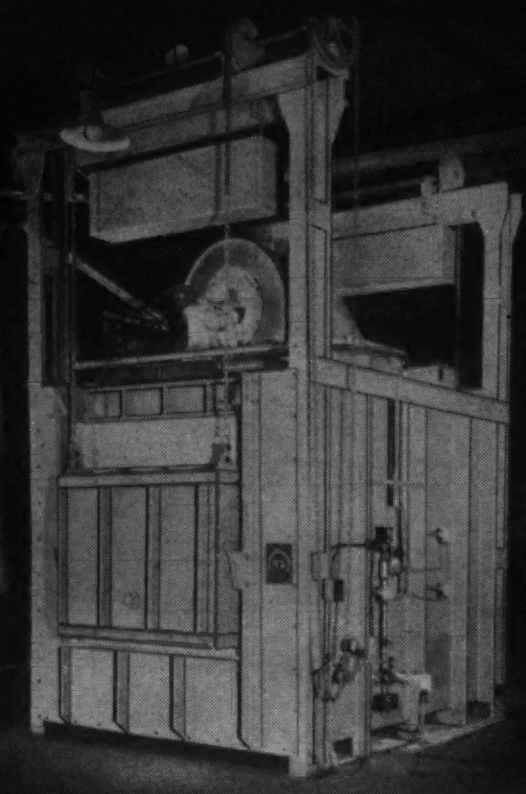
It Takes the Best TO MAKE THE BEST



HEAT-TREATED STEEL CASTINGS

Exceptionally close temperature uniformity for work requiring a maximum of 1300° F. is obtained in this small R-S Convection Type Furnace. Large volume air circulation permits rapid heating and high production. Program heating and cooling is also possible on work requiring a slower rate of heating or a definite time-temperature cycle.

Automatic temperature control and combustion safety devices with dependable air circulation and proper distribution assure a continuous flow of uniformly heat-treated material.

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BUY WAR BONDS

cathode to form a smut that will interfere with adhesion of the electrodeposit.

Reversal of the current for a short time will tend to remove all of the metallic smut. If an electrocleaner causes the steel to darken when made the cathode, particularly after 2 min. of cleaning, it is an indication of metallic contamination, and the cleaner should be discarded. However, the cleaner could be used as an anodic or soak cleaner without the metallic impurities causing difficulty.

When highly stressed steel parts, particularly high carbon steel, are cleaned cathodically, there is some danger of hydrogen embrittlement. The embrittlement in electrocleaning is not as severe as that involved in electroplating.

However, it must be remembered that some hydrogen is dissolved in the metal during cleaning, and this would contribute to the embrittlement normally obtained in plating. When steel is cleaned anodically, there is no embrittlement from oxygen.

Anodic cleaning is preferable in almost all cases except when there are chlorinated compounds present that might cause attack on the steel.

—W. R. Meyer. *Mo. Rev., Am. Electroplaters' Soc.*, Vol. 31, June 1944, pp. 511-514.

Chucking Machine Production

Condensed from "Screw Machine Engineering"

Needs of war production have caused many metal-working shops to become familiar with the machining technique adaptable for use in processing forged or cast blanks on automatic chuckers. While bar stock or tubing will be superior to cast or forged blanks, the decision as to which to use should depend upon which makes the best cost showing.

The Acme-Gridley automatic chucker, similar to the wellknown Acme-Gridley automatic bar machine, is contained in a box-type frame consisting of a pan, headstock, gear box, and top brace. The chuckers are grouped in three classes; the four, six and eight spindle types, seven capacities being available. Being multiple spindle, all machining operations take place simultaneously.

Positive chucking pressure is set by adjusting a hydraulic pressure valve that makes available a wide range of gripping tensions. Interchangeable spindle speed and feed charge gears materially decrease the setting-up time.

A good example of the type of work done by automatic chucking machines is a differential gear case. The case is in two sections, separate but with many dimensions alike. The blanks are cast from malleable iron.

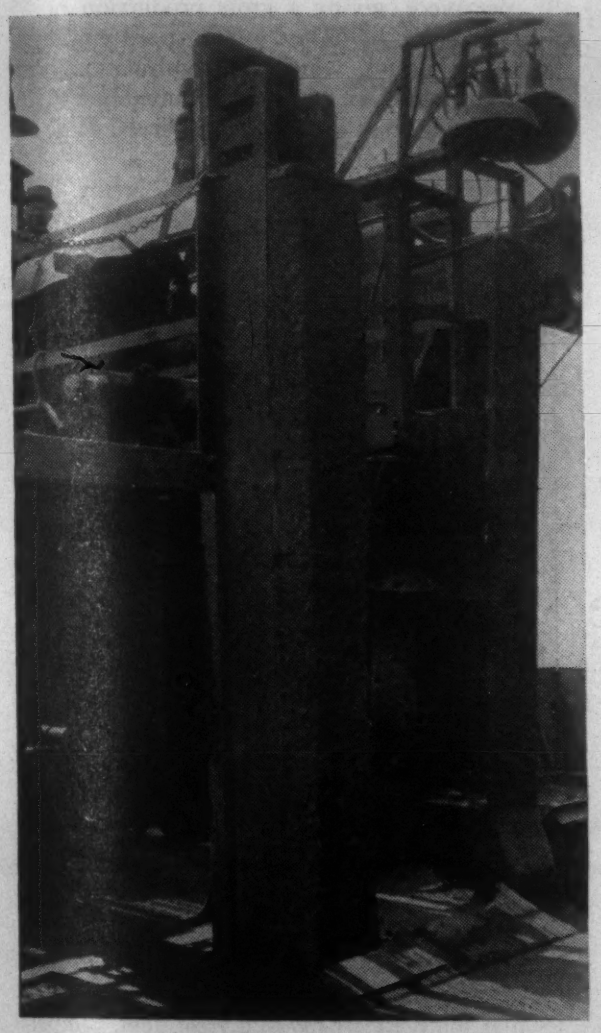
Gear Case

The left side of the case is 6⅜ in. in diam., 4 41/64 in. in overall length, including the four equally spaced lugs that protrude 2 1/32 in. beyond the case body. The $\frac{5.626}{5.624}$ in., 4 9/16 in. 3⅞ in. and $\frac{2.190}{2.188}$ in. internal diameters are all sized

AFTER 9 YEARS' SERVICE

ON GARY COKE OVENS

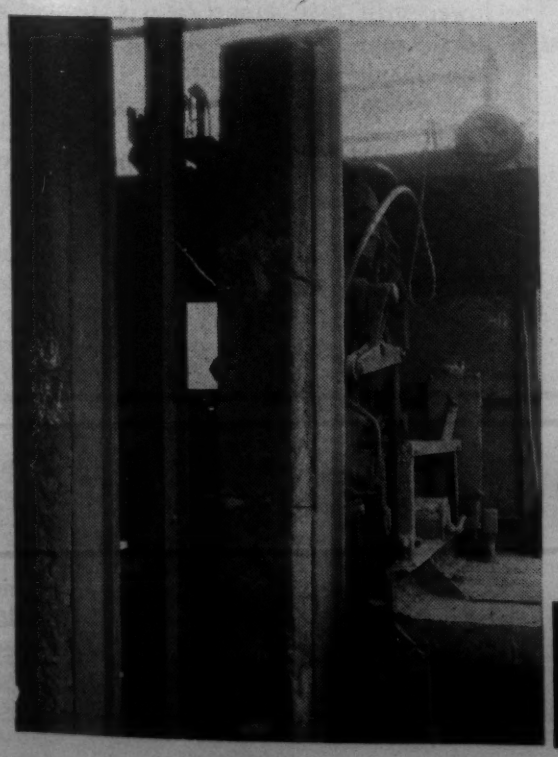
Door linings of Refractory Concrete at Gary Works of Carnegie-Illinois Steel Corporation prove their durability in continuous service



On the Pusher Side—this door lining of Refractory Concrete made with LUMNITE was installed in March, 1935. Since then, it and other LUMNITE linings in the Gary plant have been in continuous operation. Here is a record of service and low-cost maintenance that is good news any time—but especially today.

●

On the Coke Side—also 9 years old is this LUMNITE Refractory Concrete door lining—another of the many linings that are noted for their length of service at Gary Works.



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Heat-Resistant Concrete for paving battery tops and benches.

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Let us help you make use of LUMNITE in your coke plant. Write for book, "LUMNITE for Refractory Concrete." Address The Atlas Lumnite Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

This three-section lining of LUMNITE Refractory Concrete on a coke-side door at Gary Works is 3 years old and has years more of service in it. This plant, like many others, finds that it pays to use more and more LUMNITE.

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There must be no guesswork with precious lives dependent . . . products of war must give TOP performance. Everything that goes to our fighting men must be pre-tested under "fighting conditions" to assure its dependability.

Kold-Hold engineers have made this vital pre-testing a simple matter. With a Kold-Hold Altitude Chamber you can determine accurately and quickly just how the materials you use and your finished products will react and perform under all variations of altitude, cold, heat, pressure and humidity. Right on the ground, in your own plant, you can test your materials and equipment under "fighting conditions!"

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ARMY E NAVY

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and faced to the dimensions indicated. The outside diameter is turned to size and length. There is a $\frac{2.504}{2.502}$ in. internal radius that is practical to machine on the automatic.

Points of difference in the right side of the case include: Overall length, $\frac{1.971}{1.968}$ in.; $\frac{5.626}{5.624}$ in. diam., turned instead of bored; large end of internal radius held to $\frac{5.008}{5.004}$ in.; the outside diameter of 6⅜ in. cut back to a distance of $\frac{.130}{.120}$ in. from the face of the $\frac{5.626}{5.624}$ diam.

The machining of the case on the chucker is accomplished in six positions, in 48 sec. per piece, giving a gross production of 75 pieces per hr. The spindle speed employed is 90 r.p.m., which, in combination with the rough casting of approximately 6½ in. in diam., results in a surface speed of about 150 ft. per min.

Tooling for the two sides is the same except for a few changes necessitated by the differences of design.

—*Screw Machine Engineering*, Vol. 5, May 1944, pp. 42-46, 48-51.

Cold-Treating High-Speed Steel

Condensed from "Machinery"

Cold treatment of cutting tools is preferably included as part of the heat treatment, but a definite improvement is obtained even when it is given to stock tools that have already been heat treated (—120 F. for 3 to 6 hrs.). Pre-heat, high heat and quench are the same as in normal high-speed steel practice.

Then any one of the following treatments may be used: (1) Temper (2 to 4 hrs. at 1000 F. min.), cold treatment, temper (2 to 4 hrs. at 25 F. lower than first temper); (2) cold treatment, temper, cold treatment, temper (2 to 4 hrs. at 25 F. lower than first temper); (3) temper as usual, cold treatment. In each case, the cold treatment is exposure to —120 F. for 3 to 6 hrs.

The tool should be cooled to 150 F. before being placed in the cold treatment equipment; likewise, it should be allowed to warm to room temperature from the cold treatment before tempering. If the tool has sharp corners, or is large, or has been made of a high cobalt high-speed steel, it should be tempered before being given the cold treatment. Otherwise, practice (2) can be used.

If the cold treatment is given to previously heat treated tools that were not completely tempered, the hardness may increase perceptibly; then, the tool should be retempered to the usual hardness.

Examples are given of the improvement in cutting performance due to the cold treatment: drills (increased from 48 holes when not cold treated to 256 holes when cold treated); milling cutters (from 7 hrs.

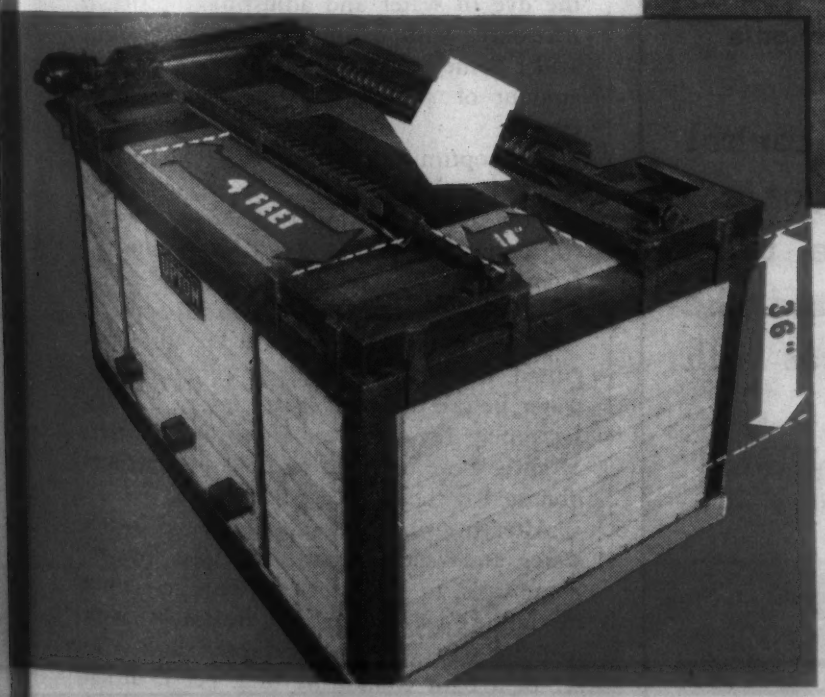
Upton ELECTRIC SALT BATH FURNACES

in ANY size ANY capacity

FOR ALL KINDS OF HEAT TREATING

The Sealed Electrode method of heating has tossed out all restrictions on salt bath furnace sizes and capacities! Upton Electric Salt Bath Furnaces can be built to any size you need—to any depth.

Upton Furnaces eliminate decarburization, reduce distortion, improve quality of finished work, require less skilled help to operate. RESULTS FROM UPTON ELECTRIC SALT BATH FURNACES ARE FOOLPROOF and COMPLETELY PREDICTABLE.



These furnaces nearing completion, indicate some of the sizes that are available in Upton Electric Salt Bath Furnaces. The long (21'-0") furnace in the foreground is for continuous anneal of brass cartridge cases. The other vertical furnaces are for High Speed and Moly Steel hardening. Other sizes are as readily available.

Ask for complete information now; Please mention the type of work to be heat treated.

Upton ELECTRIC FURNACE DIV.

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Cutting NITRIDING TIME CYCLES

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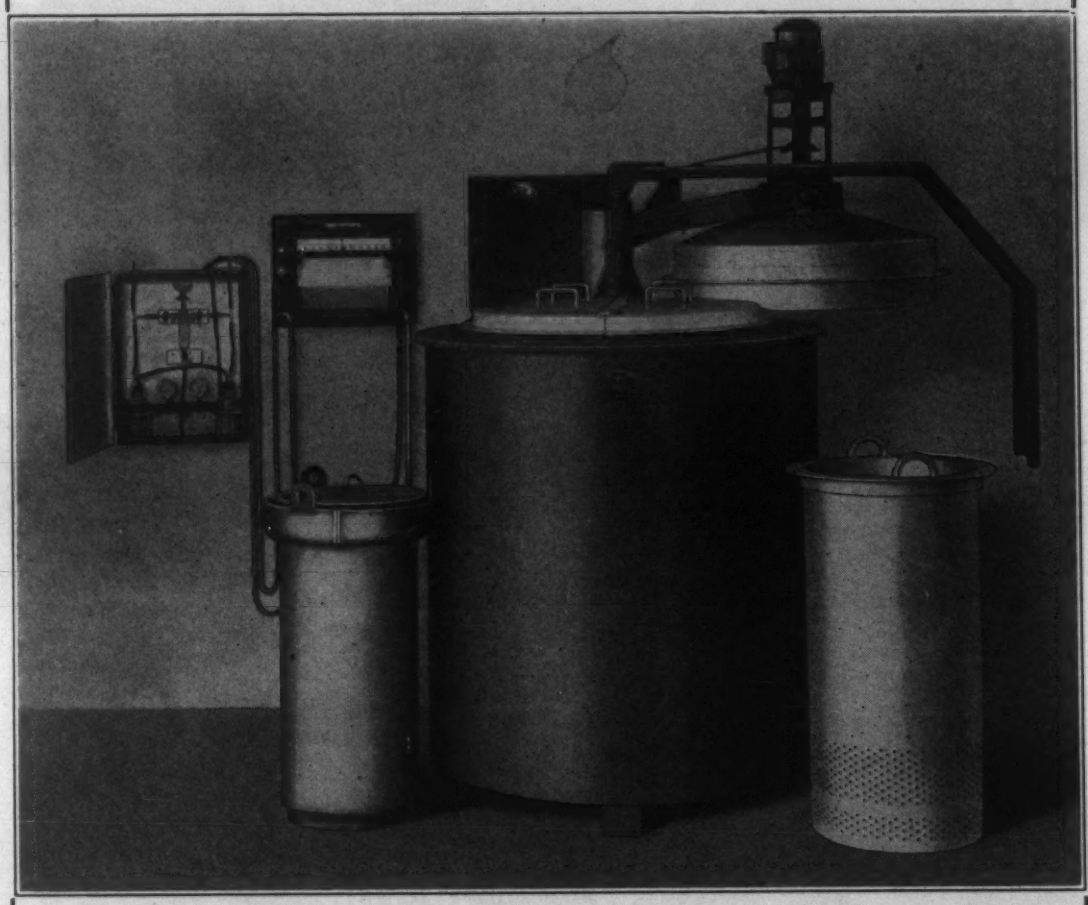

Model NA Air Tempering Furnace With Nitro Attachments

The pressure system together with precision control of time, temperature and flow of ammonia gas are resulting in unequalled advantages to the users of "AMERICAN" Electric Nitro Furnaces, and the "AMERICAN" Electric Air Tempering Furnaces with the Nitro attachments.

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29 Von Hillern St., Boston, Mass., U.S.A.

Industrial Furnaces for All Purposes

between grinds to 24 hrs.); hacksaw blades (life doubled by cold treatment); gear cutting hobs (increase from 150 pieces per grind to 510); taps (from 40 to 710 pieces); and burnishing broaches (from 216 to 648).

—F. W. Whitcomb. *Machinery*, Vol. 50, June 1944, pp. 162-164.

Dyeing Anodized Aluminum

Condensed from "Metal Finishing"

In the production of black or colored finishes on aluminum by dyeing, anodized films, dirt, grease and oil are removed from the articles by a solvent or an alkaline detergent. If a dull finish is desired, the work is etched either mechanically or by immersion in a dilute caustic soda or acid-etch solution. Better results are obtained with high silicon alloys if a preliminary hydrofluoric acid etch is used.

Die-castings of alloy No. 13 (12% Si) are etched in a solution containing one part of 48% hydrofluoric acid and eight parts of 70% nitric acid. Articles are thoroughly rinsed after etching.

Anodizing is carried out for 60 min. at 125 F. and 40 v. in a chromic acid bath containing 50 to 100 g. per l. Cr_2O_3 and with the pH maintained at 0.8 to 0.9 by periodic draw-off and addition of fresh chromic acid. Good racking with firm contacts is essential.

Since thicker films are required for dyeing than are ordinarily used, the time and temperature of treatment recommended above are both greater than are commonly used. High silicon alloys are usually treated for 30 to 35 min. at 30 v. and 95 F.

The dye bath is prepared by dissolving the dye in water and adjusting the pH, if necessary, with a small amount of acetic acid. Sometimes the addition of a small amount of sugar makes the dyeing more even.

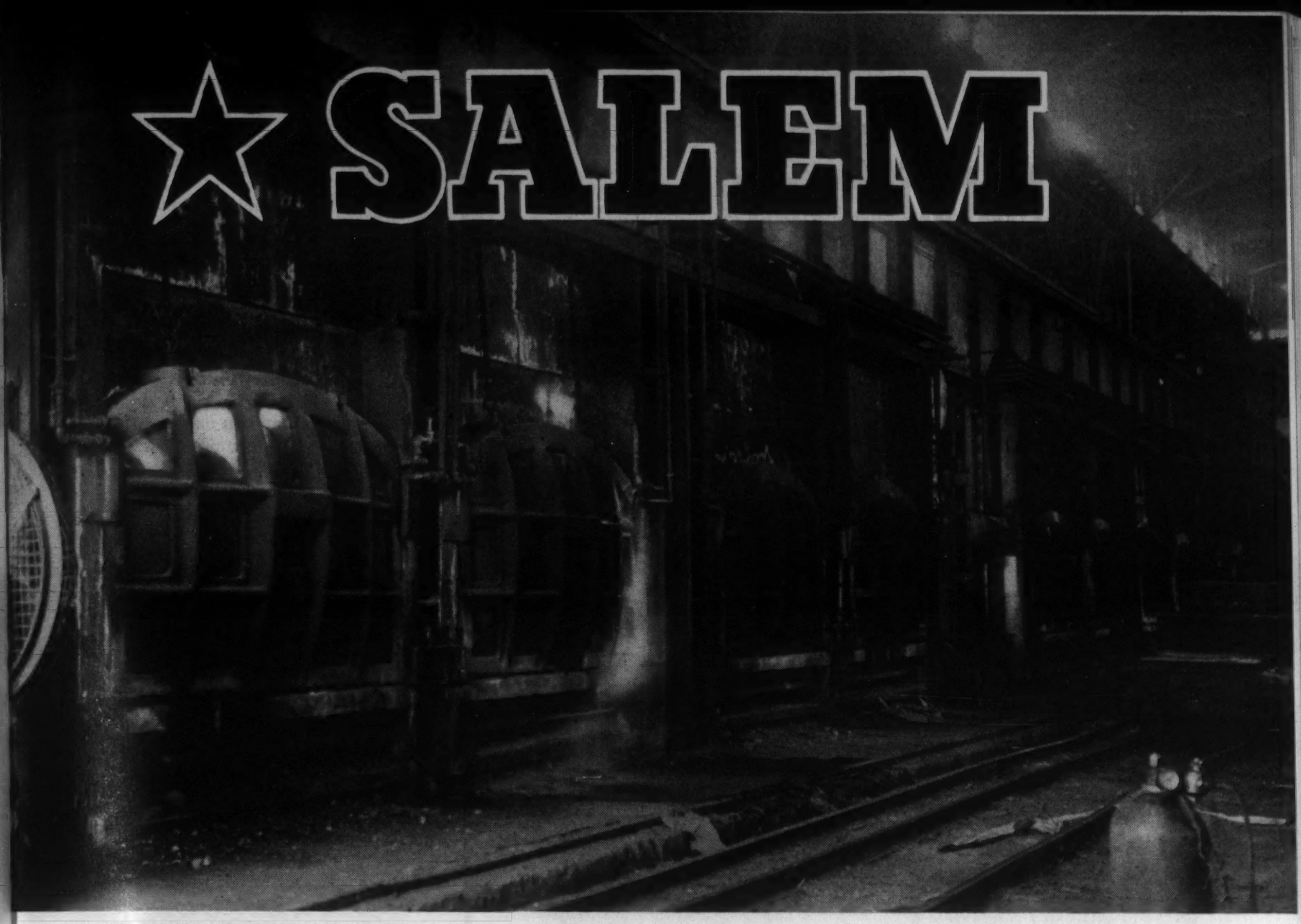
The optimum conditions of concentration, temperature, pH and time are different for different dyes. In general, the dye concentration is 1 to 5 g. per l., the pH from 4 to 8, the temperature from 125 F. to boiling, and the time 15 to 30 min.

All adhering chromic acid is thoroughly rinsed from the articles in cold or tepid water before dyeing. After rinsing, the objects may be dried, or dyed immediately. Slightly more uniform results are sometimes obtained if the parts are dried first.

After dyeing, the parts are rinsed in hot water and dried, or the dye may be set. Some dyes, to be water fast, require setting in boiling water or by treatment with metallic salts. The general procedure is to set in a bath containing 5 g. per l. nickel acetate at a pH of 5 and a temperature of 200 to 210 F., for 10 to 20 min. After setting, the object is washed in hot water and dried. Light fastness depends on the nature of the dye.

Some manganese-bearing alloys produce an interesting grain effect following the rolling lines of the sheet.

—M. Darrin & L. G. Tubbs. *Metal Finishing*, Vol. 42, Mar. 1944, pp. 141-144.



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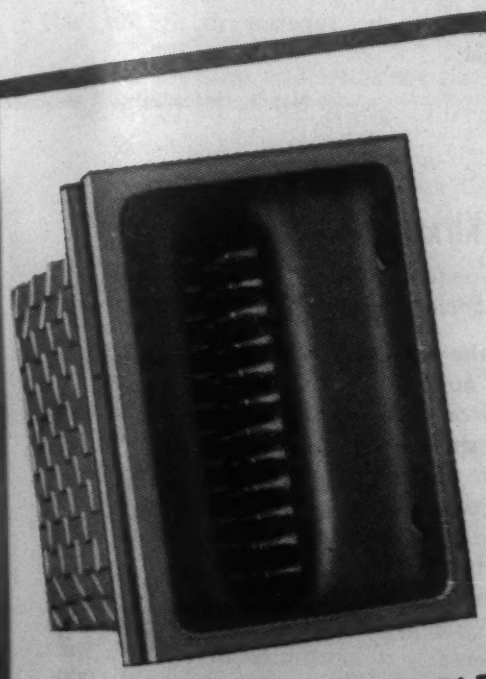
Batch Type Ingot Heating Furnace



PATENTED NEEDLE PRINCIPLE

The Salem Recuperators used in Salem-built furnaces are made of a special alloy steel known as "Lisconite" and should not be confused with the conventional refractory recuperator.

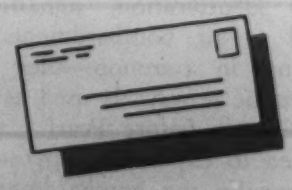
● Rugged construction with water-cooled door frames, plus automatic heating controls make the recuperative type Salem ingot heating furnace an efficient, economical, heavy tonnage producer. The furnace handles ingots as large as 22x53x78 at a heating rate of 6.4 tons per hour.

By placing ingots on edges with space between, heat penetrates each side of the ingots uniformly. Special firing and recuperation of air nets as much as 30% saving in fuel costs, as shown by actual operating records.

Economy from any furnace installation results from correct application of heat, right type of burners, and proper installation. As builders of all sizes and types of heat treating furnaces and circular soaking pits, Salem specializes in automatically controlled heat, properly applied.

Salem builds heat treating furnaces for oil, gas, or electric firing. The installation described above uses coke oven gas.

Your furnace inquiry to Salem will receive prompt attention.



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4 Materials and Engineering Design

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Metal Powders in Pyrotechnics

Condensed from a Paper of the Metal Powders Association

Military pyrotechincs include signals, flares and photoflash bulbs, and are used for identification, signalling, and as an aid to air bombardment. All have one thing in common—they emit light. A metallic powder is used as the fuel.

Shortly before Pearl Harbor it was decided to expand the pyrotechnic program, especially the bombardment flare. Because of an acute shortage of magnesium, aluminum powder was substituted. Metallic aluminum, after exposure to the air for a short period, becomes coated with a relatively impervious coating of oxide, which inhibits the deteriorating action of moisture. Metallic magnesium does not become so coated, and must be protected. Linseed oil is the most used protecting material.

Ordnance specifications call for magnesium powder in grades A, B, C and D, the difference being in degree of fineness and partial size. Most producers did not experience much trouble with the coarse C powder, but had many difficult problems with the finer A and B grades. Close cooperation among members of the industry solved most of the difficulties, and today practically every manufacturer has sufficient flexibility in his plant to make any required grade.

In all pyrotechnics, except photoflash bulbs, the ingredients are mixed and pressed into a metal or paper case. Ignition is accomplished by priming the end with black powder and/or "quick match."

White light is produced by the high temperature oxidation of the metallic fuel. At this high temperature small metallic oxide particles form a dense white smoke. Magnesium oxide particles are more incandescent than aluminum oxide particles.

Degree of granulation of the metallic powder bears a definite relationship to the burning rate of the composition. The methods of producing metallic powders result in as many different shapes of granules, with different ratios of surface area to weight of powder, and candlepower and burning rate bear a definite relationship to this ratio. A rough indication of this difference is obtained by measuring the "apparent specific gravity" of the powders.

The ideal photoflash powder produces a light flash of high intensity for a fraction of a sec. The powder dare not be coated with any corrosion-resistant substances, since these would retard the rate of burning. Elaborate precautions are necessary to exclude moisture from the powder container. The powder is ignited by firing a small pellet of metal into the mixture.

The original powder consisted of a mixture of magnesium powder, aluminum powder, and potassium perchlorate. The mixing of the powders presented a safety problem, and was difficult to adapt to large scale production. What is known as X-alloy, approximately 50% Al and 50% Mg, was evolved. Being friable, it was easily broken up into small pieces, and a milling operation put it into powder shape. It proved to be superior to the original material.

—Leo Pasternak. Paper, *Metal Powders Assn.*, May 5, 1944 meeting, 5 pp.

Kirksite Molds for Plastics

Condensed from a Paper of the Society of the Plastics Industry

In the aircraft industry a comparatively small number of duplicate parts are required on most plastic items, so that steel molds show high cost per part because the life of the mold has barely begun when production of the part is completed. The zinc alloy, Kirksite, has been used successfully for molds for these limited production items.

A mold was designed on the basis of an operating temperature of 350 F. and a maximum molding pressure of 10,000 p.s.i. The position of a core was located by means of two steel pins. Sprues were located at 120° from a common center.

In making the mold of Kirksite master wood patterns were made, and plaster splashes prepared from these. Kirksite sand castings were made from the wood patterns and plaster splashes. Copper tubes were cast in each half of the mold for steam for heating if necessary.

Finishing operations consisted of scrap-

How to find a dozen ideas

They're all in this molded Durez aircraft sextant case...a dozen and more ideas for designers, engineers, and production men. The case is an excellent example of ingenious solutions to very difficult molding problems and of the reasons for specifying a Durez phenolic.

Sextants, of course, must be protected from the bitterest moods of climate and geography. As far as service requirements go, almost everything in the book is thrown at these Durez cases —from salt spray and fog to blistering heat and freezing cold. Most of the service conditions to which your own products may be exposed are probably part of the daily life of the sextant case.

Versatility is the outstanding property of Durez. Check off a few of its characteristics. There's light weight, yet tensile strength is very good. There's impact strength which can take plenty of punishment. There's the fact that extreme temperatures affect neither inherent properties nor dimensional stability. There's powerful resistance to the corrosive attacks of chemicals, oils, mild acids and alkalies. And, there's a series of electrical properties which make Durez a first choice for that industry.

In the versatility of Durez may lie at least part of the answer to your production and merchandising problems. For instance, ease of moldability, another characteristic of Durez compounds, provided part of the answer to the highly complicated molding problem of the sextant case. We suggest that now is the time to start talking it over with your custom molder. And we are always ready with valuable data and personal assistance in answering plastic materials questions. Write to Durez Plastics & Chemicals, Inc., 98 Walck Road, North Tonawanda, New York.

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ing, machining, polishing, and fitting. Surface imperfections uncovered were repaired by welding and rescraping or by drilling and plugging.

Later studies showed that castings in antioch plaster molds were superior to those made in sand. Hobbing of die cavities was found to be possible by heating the work to 350 F., at which temperature the Kirksite shows no appreciable plastic flow, but the tendency to crack was markedly decreased. It would seem that considerable forging action took place during hobbing.

The Kirksite comprising the cavity proper appeared to be more dense, harder, and more scratch-resistant than the "as-cast" material. Satisfactory displacement occurred at 3500 to 4500 p.s.i., increasing with the depth hobbed.

Kirksite molds showed the unique property of non-adhesion to any of the phenol-formaldehyde, urea-formaldehyde, and phenol-furfural molding compounds tested to date. An indefinitely long life at pressures as great as 2000 p.s.i. may be expected. The operating temperature, 315 F., did not appear to have affected the surface of the mold.

Where a highly polished surface might be desired on a part, a flash plating of hard chromium could be applied to the Kirksite.

—Carrel C. Sachs, Paper, *Soc. Plastics Ind.*, meeting, 5 pp.

Notch Sensitivity of Steels

Condensed from "Luftfarhtforschung"

In order to determine notch sensitivity of austenitic steels at room temperature and at elevated temperature, tensile tests and tensile fatigue tests were made at 20 C., 450 C. and 600 C., with the following steels:

A, 0.12 C, 0.80 Si, 0.70 Mn, 9.3 Ni, 17.9 Cr, 0.93 W, 1.8% Ta+Cb; B, 0.12 C, 0.92 Si, 0.71 Mn, 29.2 Ni, 15.3 Cr, 1.6% Ti; C, 0.06 C, 0.65 Si, 0.85 Mn, 36.2 Ni, 22.8 Co, 13.7 Cr, 4.4 Mo, 4.9% W.

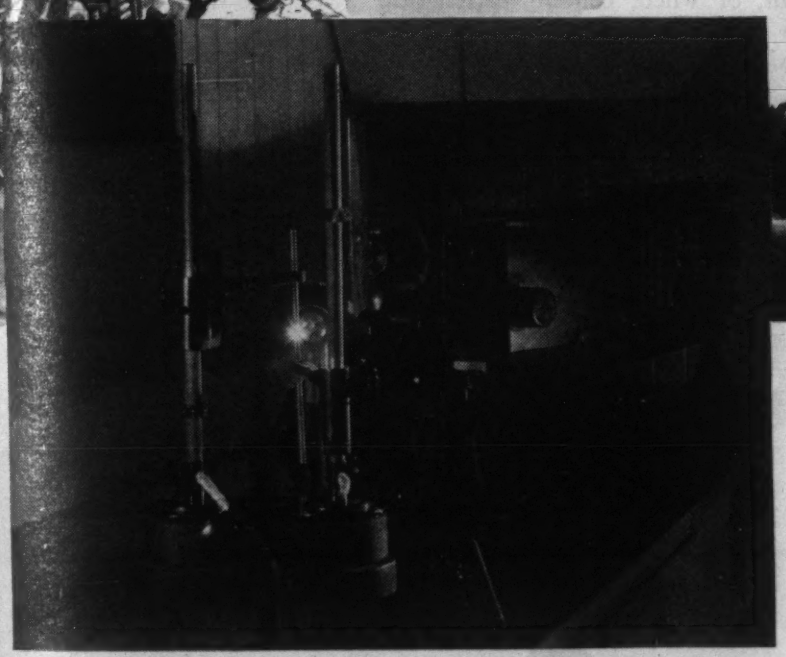
The tensile test does not allow conclusions about the influence of notches on fatigue strength. Steel A, when annealed at 800 C. and air cooled, was stronger in all cases than the same steel subjected to the same procedure at 1050 C. The same is true for untreated steel C compared with steel C annealed at 1250 C.

The following results at high temperatures were obtained:

Steel	Annealing Temp.	450 C.		600 C.	
		No Notch	Notched	No Notch	Notched
A	800	54000	50000	48000	48000
A	1050	47000	45000	45500	47500
B	—	68000	49000	47000	48000
C	—	66000	64000	61000	63000
C	1250	52000	41000	47000	40000

In general, however, it is necessary to consider elongations caused by creep even at 450 C. when structural uses are planned.

—H. Cornelius & W. Schmidt. *Luftfarhtforsch.*, Vol. 20, No. 10, 1943, pp. 292-296.



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The close laboratory control that made this superior quality possible will continue to benefit industry on the return to peacetime production. It will be ready to assist in the making of better castings at minimum cost for better civilian products. It will help pave the way for the development of new applications and new uses of aluminum alloys for better living.

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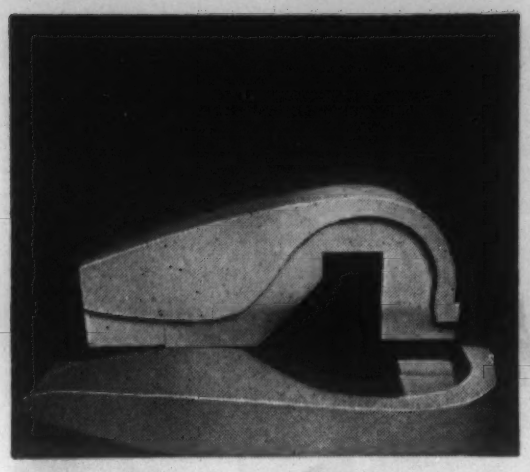

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Die Castings for Motors

Condensed from "Die Casting"

In the mass production of small fractional horsepower motors of the general sizes and types used for airplane requirements, die casting is not only the most advantageous process for the production of housings, it is virtually the only sound basis for high volume precision production in this field.

Virtually all Dumore motor housings and many such small parts as fans, bearing adapters, connector and overload device housings are die cast—chiefly of aluminum alloys, though certain motor housings are cast in zinc alloys.

There are a number of design advantages which die casting lends to the manufacture of fractional horsepower motors. Some of these are:

1. Intricate design details can be cast into such a part as a motor housing with accuracy details, such as thin-walled lead channels, cooling fins, etc.

2. The fidelity with which such details are reproduced by the die casting process applies also to the components in which contours are important, or where concentricity, uniformity in wall thickness and uniformity in dimensions must be maintained.

3. The design need not provide extra thickness in cross-section to allow for wide variation.

4. The weight-strength ratio is favorable in spite of the thinner wall sections because the greater density of a die casting requires less metal, yet provides greater strength than would be afforded by a sand casting of the same thickness.

5. Design economies are possible in variations of an established motor type.

6. The ability of die casting to reproduce exact detail with dependable uniformity allows the stamping of parts numbers and trademarks in the cores so that each casting is self identifying.

7. Design engineers take advantage of the characteristics just mentioned to incorporate eye-appeal into the original design detail of the casting.

Many production advantages emanate from the same characteristics though described as design advantages. Very little machining is required for die castings because dimensions are faithfully held.

Actually, the only machining is on areas involved in telescopic fits—where we require a tight fit with perfect alignment. The dies used are not particularly complicated.

A regular procedure of quality control inspection is maintained. The inspections made of this general nature are: (a) For eccentricity of I.D. and O.D. as a check on the trueness of the guide pins of the core

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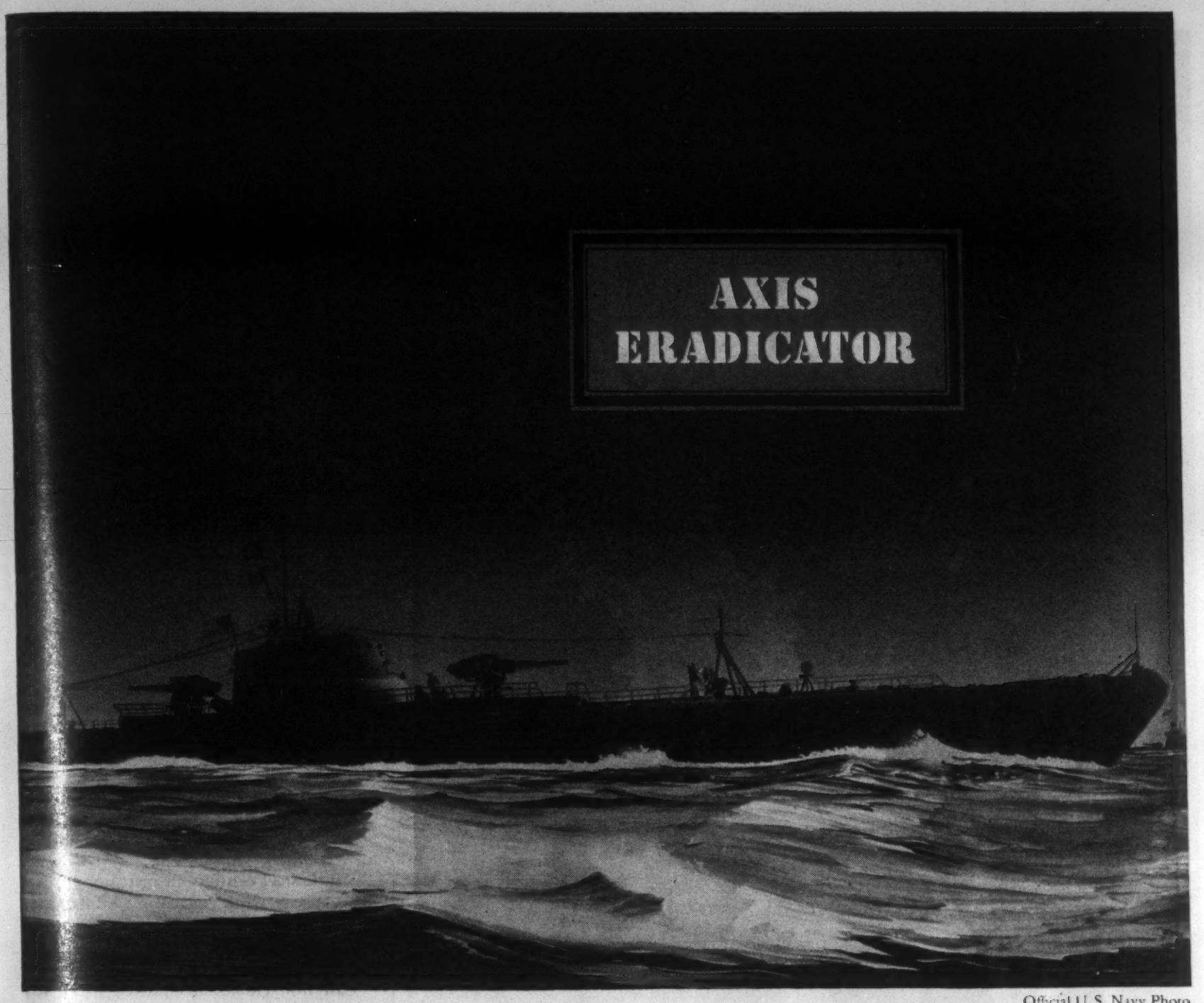

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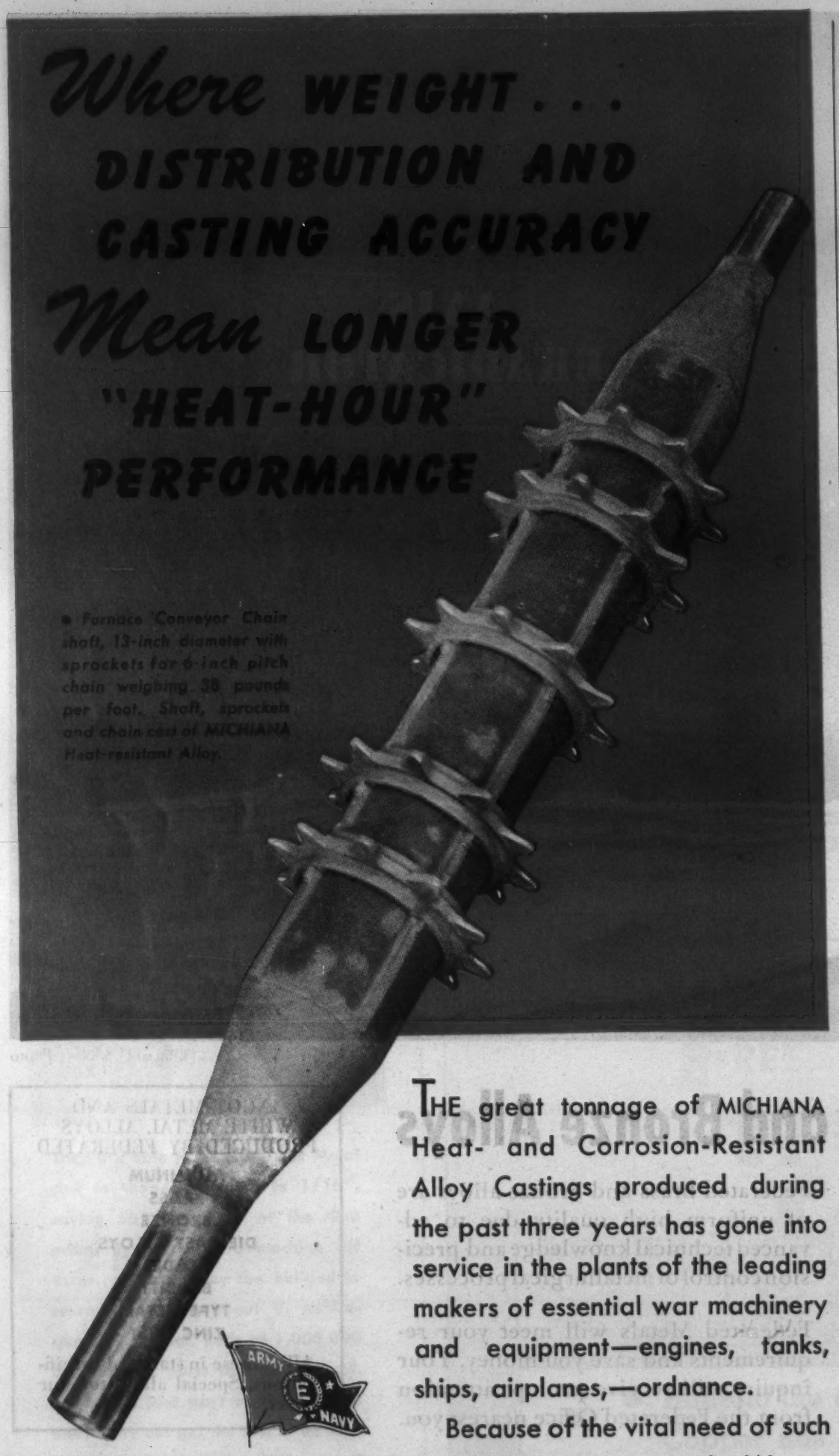

THE great tonnage of MICHIANA Heat- and Corrosion-Resistant Alloy Castings produced during the past three years has gone into service in the plants of the leading makers of essential war machinery and equipment—engines, tanks, ships, airplanes,—ordnance.

Because of the vital need of such equipment to prosecute the War,—the dependability of MICHIANA and the recommendations of MICHIANA metallurgists and specialized alloy foundrymen have been recorded as worthwhile contributions.

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die; (b) to check diameter and depth dimension of bearing seats with respect to brush holder holes.

(c) To check dimensions of holes as to individual diameters; (d) of I.D. of compressor motor housing to insure a good fit for field core as the die wears; (e) to discover any scoring on the inner wall.

It appears that the die casting industry is keeping its own methods abreast of materials developments and is not seriously threatened.

—Howard F. Doll. *Die Casting*, Vol. 2, June 1944, pp. 36-41.

Cast Iron for Construction

Condensed from "The Engineers' Digest"

With the partial abandonment of former conceptions of strength and the gradual development of a new theory of design, cast iron has been given a new impetus as a construction material. While earlier ideas of strength were based upon the elastic behavior of the material, present-day tendencies are toward the consideration of contour, damping, surface condition, local stress concentration, and other factors.

Cast iron, while having small static elongation, exhibits to a large extent the properties of high damping, low notch sensitivity, and high resistance at the root of the notch. It shows a particularly pronounced property of distributing local stress to neighboring zones.

While steel exhibits an increase in damping capacity with increasing stress, good damping characteristics in the low stress range encountered in practice is an almost unique property of cast iron.

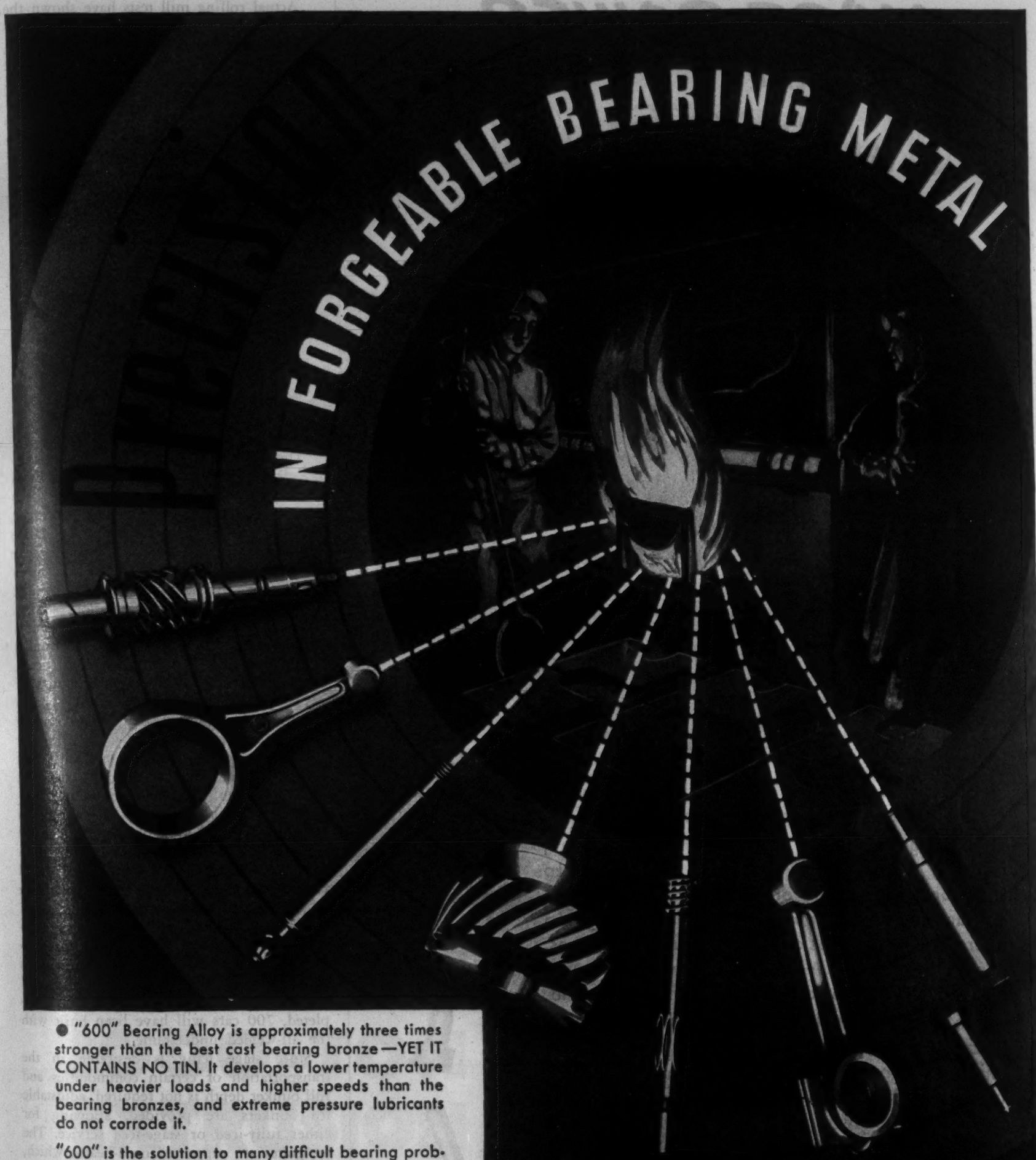
Cast iron crankshafts proved to be very successful in resistance to fatigue. It has been shown that, in spite of lower tensile strength, cast iron structures may exhibit a fatigue strength that may be lower, equal to, or even superior to steel.

Modern high grade cast iron can be competitive even with forged steel, since it is easily given a required shape, possesses small shrinkage, small tendency to piping, and is easily machined.

Steel above 0.35% C offers certain difficulties to welding. Strength values of welded parts of carbon content below 0.35% are not much higher than those of high grade cast iron.

In judging the brittleness of cast iron, considerations must be applied as to whether the stresses involved lie above or below the fatigue limit. E. Piwowarsky has suggested the terms "dynamic brittleness" or "dynamic toughness" for impact loads below the fatigue limit, and "blow brittleness" or "blow toughness" for destructive blows. The increased tensile strength obtainable from high grade cast iron is known to be accompanied by extraordinary increase in impact fatigue strength.

By careful avoidance of abrupt changes of section and use of large corner radii, it has been found possible to produce cast iron crankshafts with a fatigue strength 25% greater than that of a comparable crankshaft of forged alloy steel.



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"600" is the solution to many difficult bearing problems. It can be drawn or forged and readily fabricated in a great variety of sizes and shapes.

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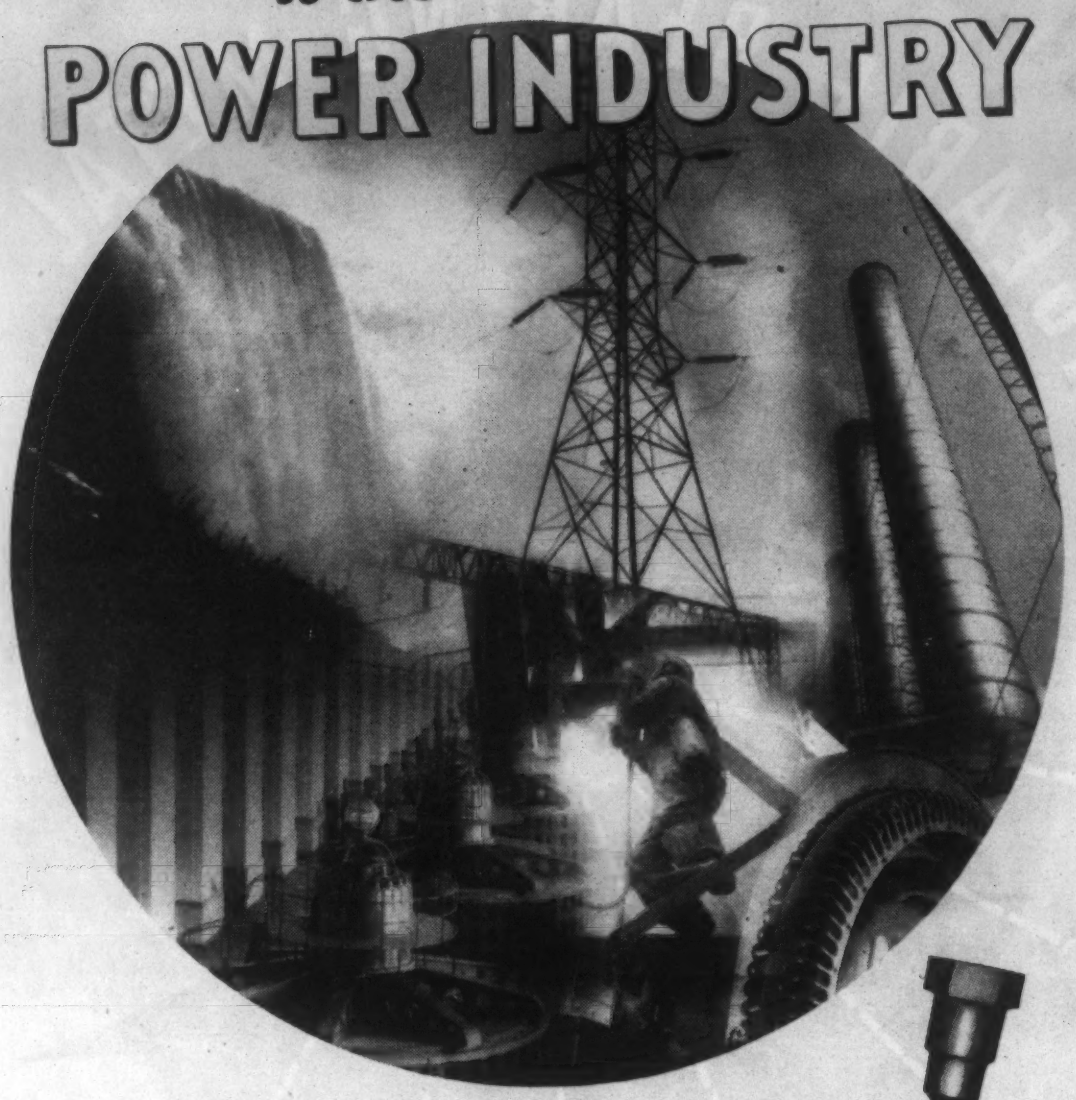

★ Electric power is the very life blood of industry. Without it, mass production ceases.

The gigantic power industry, without fan-fare, is doing a tremendous job today. In addition to the normal demands of industry and domestic consumers, it is supplying electrical energy to operate the machines of war that turn out planes, guns, ships and tanks—energy to drive motors that make our great nation the arsenal of the world.

We of the TITAN METAL MANUFACTURING COMPANY applaud this gallant industry which is doing such an amazing job, and take pride in the fact that TITAN Brass Hot Pressed Parts are used in many types of electrical equipment.

The TITAN plants are now working to capacity on war orders, but in the post-war market, when economy becomes a primary consideration, *TITAN Hot Pressed Parts* will again be available.

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Actual rolling mill tests have shown the feasibility of rolling cast iron. The reduction per pass ranged from 10 to 20%, comparable to that for hard steel. Tensile strength and elongation showed large increases.

A development used for only a few parts in the past, but showing promise for the future, is the use of reinforced cast iron. Use of 3 to 5% by weight of steel reinforcement leads to an increase of 2.5 to 3.5 in bending strength.

An armored cast iron slag ladle is covered by a German design patent.

—E. Piwowarsky. *Die Giesserei*, Vol. 30, June 1943; pp. 141-152; abstracted in *Engineers' Digest*, British, Vol. 5, Mar. 1944, pp. 61-64.

Plywood Refrigerator Cars

Condensed from "Railway Age"

The use of plywood for cars built by the Fruit Growers Express has increased during the past several years, and has been further accelerated by critical steel shortages. Plywood has proved satisfactory as outside sheathing. Plywoods of the exterior type are used, representing the ultimate in moisture resistance, with a ⅜-in. ceiling, a ⅜-in. thickness under the floor pan, a ⅞-in. top floor and 9/16-in side sheathing.

Just now 225 40-ft. end-ice bunker refrigerator cars are being constructed, interesting because of larger amounts of plywood used and because of the type of adjustable ice bunker that this company has developed.

The use of welded underframes in freight cars is becoming increasingly common, and this manufacturer has found it a particularly valuable method of fabrication from the point of view of shop output and car maintenance. Parts are assembled in five operations on jigs designed to hold close tolerances, and to permit welding of all parts in a downhand position.

Women welders have performed satisfactorily. The fact that all work is positioned enables them to give a maximum of satisfactory work with a minimum of fatigue. When the present order is completed, 700 cars will have been built with the all-welded underframe.

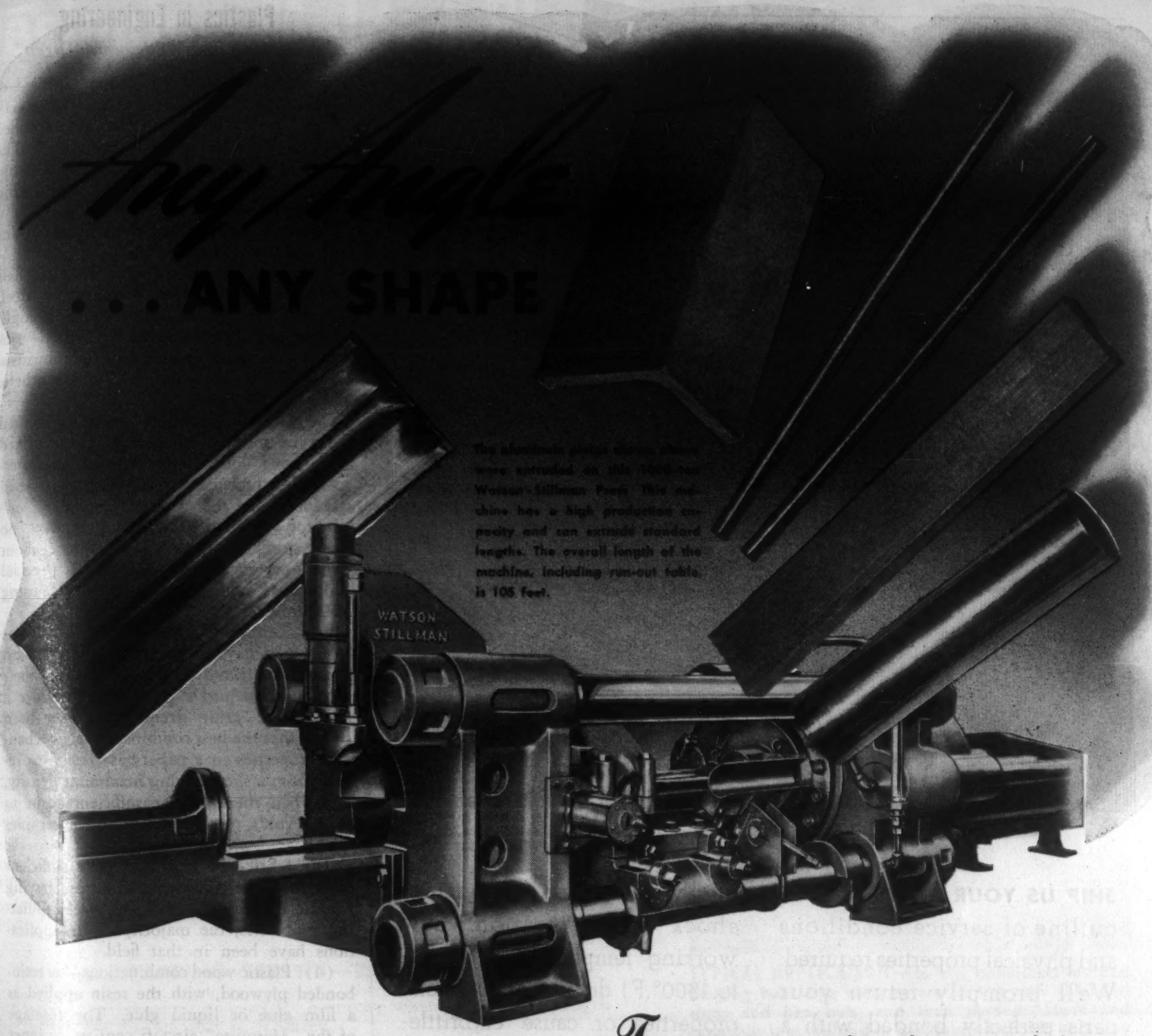
Since stage icing is desirable in the transportation of certain commodities and full bunker depth is not required, adjustable ice bunkers are provided, allowing for either fully-iced or stage-iced service. The ice grates are supported on I-beams which, when at floor level, allow a full-stage icing depth of 6 ft. 3⅜ in.

Other I-beam supports provide for lowering and holding of the grate to limit the icing depth to 3 ft. 3⅜ in. Where refrigeration is not wanted the bulkhead can be rolled toward the end of the car to give 37 ft. 4 in. loading length, as compared with the 33 ft. 2¾ in. available when bulkheads are in normal position.

The cars are insulated with a total protection of 3½ in. in the floors, 3 in. at the sides, ends and doors, and 3½ in. in the roof. Ice bunkers have a total capacity of 263 cu. ft., and will accommodate 9,600 lb. of chunk ice.

—*Railway Age*. Vol. 116, June 3, 1944, pp. 1075-1077.

Any Shape . . . ANY SHAPE



The aluminum gauge shown above was extruded on this 1000-ton Watson-Stillman Press. This machine has a high production capacity and can extrude standard lengths. The overall length of the machine, including run-out table, is 105 feet.

Produced on this 1000-TON EXTRUSION PRESS

The increasing use of non-ferrous metals in war industries has made this Watson-Stillman horizontal metal extrusion press one of the most popular pieces of equipment. It is only one of a line of Watson-Stillman hydraulic presses for extruding aluminum bars, angles, rods and many unusual shapes and materials required in the building of fighting equipment. This machine operates by centralized remote controls, is compact in construction and has a production capacity equal to the ever-increasing needs of the war effort and, after the war, the proven worth of these presses will be invaluable in peacetime production. The Watson-Stillman Company, Roselle, N. J.

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Plastics in Engineering

Condensed from "Engineers' Digest"

The term "plastics" is loosely applied to a wide collection of industrial products, some entirely synthetic, some modified natural products of long standing. The synthetics are here considered, their properties being reviewed from the engineering standpoint.

With respect to fillers, the synthetic resins fall into four groups:

(1) Unfilled resins—have less than half of the specific tensile strength of steel. (Resins are seldom used where strength is the main requirement.) Typical uses are in dielectrics (polystyrene), cable insulation (polyvinyl chloride), and synthetic fibres (nylon, vinyon).

(2) Molding powders—partly condensed resin in solution or powder form mixed with wood flour, chopped fabric, or asbestos. The condensation of the resin is then advanced, and the material ground to powder for molding. The moldings have no great strength (modulus of rupture about 3 tons per sq. in., or 6700 p.s.i.). Special shockproof moldings may be made using long fibres.

(3) Laminated sheet—since cellulose fibers may have a specific tensile strength four or five times that of the metals, their incorporation into a plastic may produce a material of great strength. It has been shown that the best combination of mechanical properties in a paper-base laminate results from a sheet having maximum density, *i.e.*, when there is just sufficient resin to fill the voids, or about 35% for the samples tested.

The fabric-base laminates have sufficient strength to be considered as stress-carrying materials. Because of its electrical insulating properties, the majority of its applications have been in that field.

(4) Plastic-wood combinations—as resin-bonded plywood, with the resin applied as a film glue or liquid glue. The fuselage of the "Mosquito" aircraft consists of inner and outer skins of resin-bonded birch with a balsa core. Compressed and impregnated laminated wood are used in airscrews to obtain a part of variable density.

Most plastics tend to gain or lose moisture as atmospheric humidity varies, and this causes changes in dimensions, weight and strength, which engineers must consider. Reinforced plastics have high specific tensile strength, and so would seem to have possibilities as the members in construction, but weakness in shear makes rather large end-fittings necessary.

For use in struts, beams, etc., the chief advantage of plastics is their ability to withstand buckling in low-stress sections for which very thin metal would be used.

Plastic bearings can function satisfactorily under high-duty conditions when lubricated with ordinary tap water. A report from Germany describes an aero-engine in which thin layers of resin-bonded fabric were wound round steel journals and run in steel housings. It was claimed that the bearing showed no deterioration after 200 hr. running at 80% of maximum output. Normal engine oil was used as a lubricant.

—S. Livingston Smith. Paper, *Instn. Mech. Engrs.*, Dec. 10, 1943 meeting; abstracted in *Engineers' Digest (British)*, Vol. 5, Mar. 1944, pp. 214-218.

Designing Molded Plastics Parts: ASSEMBLY METHODS

From the engineering files of One Plastics Avenue

There are a number of methods by which plastic parts may be joined together or assembled with other materials. However, few standards exist for such design, most methods being selected to suit a specific problem. To insure satisfactory performance in finished assemblies, consider the following general design points:

1. Allow for thermal expansion and aging characteristics when designing rigid mounting between plastic and dissimilar materials.
2. Threaded inserts are recommended where frequent disassembly is anticipated. They likewise allow for adjustment of assembly and provide good strength.
3. Special devices well adapted to plastic assemblies include speed clips, self-tapping screws, drive screws, spring hinges, and spun-over rivet-type inserts.
4. Most thermosetting plastics may be cemented together to form a reliable seal. Pressure bonding and bake may be required.
5. Thermoplastics can usually be cold-joined with a solvent such as acetone. Thermoplastic seals may be made over a lug or rim by hot-forming.
6. Integral threads constitute a good method of assembly. Consideration should be given to economies of molding thread versus machining after molding.

BODY INSERTS

Inserts with male or female threads may be incorporated in molded parts to provide a positive means of assembly.

Metal parts may be fastened to rivet-type inserts by spinning down the rivet head. Tubular inserts may be inserted in molded holes subsequent to molding to provide a similar assembly.

Inserts to carry assembly load should provide shoulder protruding above face of plastic or retain stress on metal components.

SELF-TAPPING SCREWS—DRIVE SCREWS

Self-tapping screws may be used for economy when moderate strength and infrequent disassembly is expected.

Drive screws may be used for long holes and permanent assembly.

Holes for either of above may be molded or drilled.

MOLDED THREADS—TAPPED THREADS

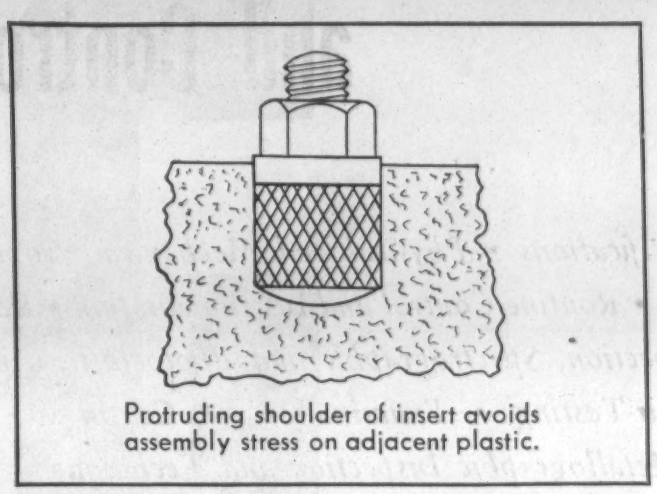
Two or more plastic parts may be assembled with molded threads. Avoid designs requiring long engagement of plastic threads to metal threads since shrinkage of plastic may shorten pitch of molded thread.

Tapped threads may be satisfactory for units requiring infrequent disassembly. In general, avoid tapped threads of greater than ¼ in. diameter and give consideration to the particular type of plastic involved, as some plastics are better adapted to machining or service requirements than others.

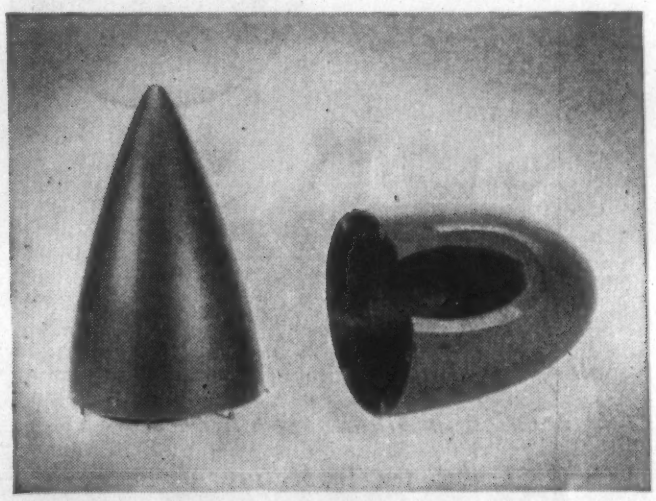
HINGES AND CLIPS

Stamped metal parts may be used for hinges, knobs, or handles. Metal hinges may be attached to plastics with screws or inserted into properly designed recesses in molded parts. Hinges may also be molded as integral part of plastic piece.

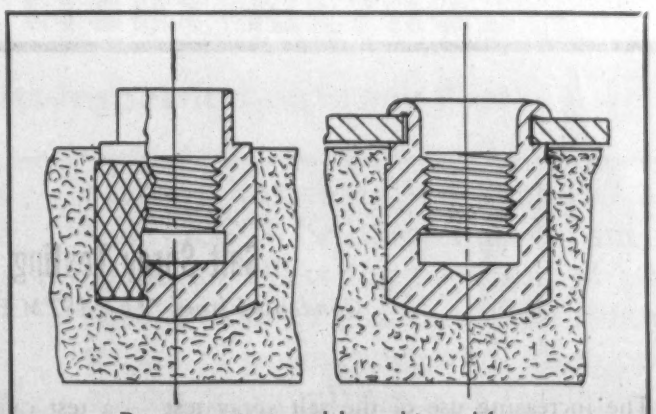
Speed clips are available for economical assembly, usually permanent. They frequently provide locking for vibration-proof qualities.



Protruding shoulder of insert avoids assembly stress on adjacent plastic.



TYPICAL APPLICATION—In this unfinished molded housing two large sections are joined with threaded studs and hex nuts, and then sanded. Studs and assembly lugs molded in part insure tight fit and easy assembly.



Permanent assembly achieved from spinning over tubular insert

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Salt Spray Testing

Condensed from "The ASTM Bulletin"

The increasing use of the salt spray test as a requirement in many specifications for protective finishes makes standardization essential for reproducible results. Lack of adequate methods for measuring and maintaining a uniform concentration of salt fog inside the cabinet is believed primarily responsible for most irregular salt spray test results.

Methods proposed in the past depend on the density of the fog, and do not distinguish between wet and dry fogs or between salt fog and fog free from salt.

The atomizing of a 20% salt solution results in a relative humidity of 84% inside a test cabinet. A lower humidity indicates that the salt particles of the fog will give up moisture to the air and tend to become a dry salt fog. Furthermore, a sodium chloride content in the collected fog solution exceeding 20% indicates there has been some loss of moisture from the salt fog particles to the air inside the cabinet.

Test results indicated good agreement of humidity as obtained from salt concentration measurement of fog solution collected and humidity measurements by wet and dry bulb thermometers. No difference in the appearance of the fog was observed whether water, 10% salt or 20% salt solution was atomized; therefore, previous methods would not have indicated any difference in the fog in spite of varying humidity and salt concentration.

Since the method of collecting a solution of fog and determining its salt concentration is more convenient than humidity measurement, the following procedure is suggested for calibrating the salt fog:

If a fog collector (10-cm. glass funnel inserted through a stopper in a 100-ml. graduated cylinder) is placed in a vertical position near the test specimens, 2.0 ± 1 ml. of solution having a sodium chloride concentration between 18 and 23% shall be collected in 1 hr., based on an average run of not less than 16 hr. At least two fog collectors should be operated during the testing period, one at a minimum distance from any nozzle and the other a maximum distance from all nozzles.

While it is agreed that the corrosiveness of a salt fog is dependent upon whether it is wet or dry, and that the concentration of salt in the fog is a measurement of the wetness or dryness of the fog, it is necessary to obtain more experimental data on the permissible limits of fog solution necessary to collect each hour.

Other important factors in the salt spray test that should be given consideration are: Salt (should not contain over 0.1% sodium iodide or over 0.2% total impurities); salt solution (20 ± 2 parts by weight of salt in 80 parts by weight of distilled water; of 1.126 to 1.157 at 92 to 97 F.; should be filtered before being placed in reservoir); salt solution reservoir (should be cleaned weekly and concentration of solution determined each day with a suitable hydrometer); pH of salt solution (6.5 to 7.2); salt fog chamber temperature (92 to 97 F.); air cleaner and saturator (compressed air should be clean and have a relative humidity not less than 85%); baffling the salt fog (fog should not impinge directly upon test specimens after atomization).

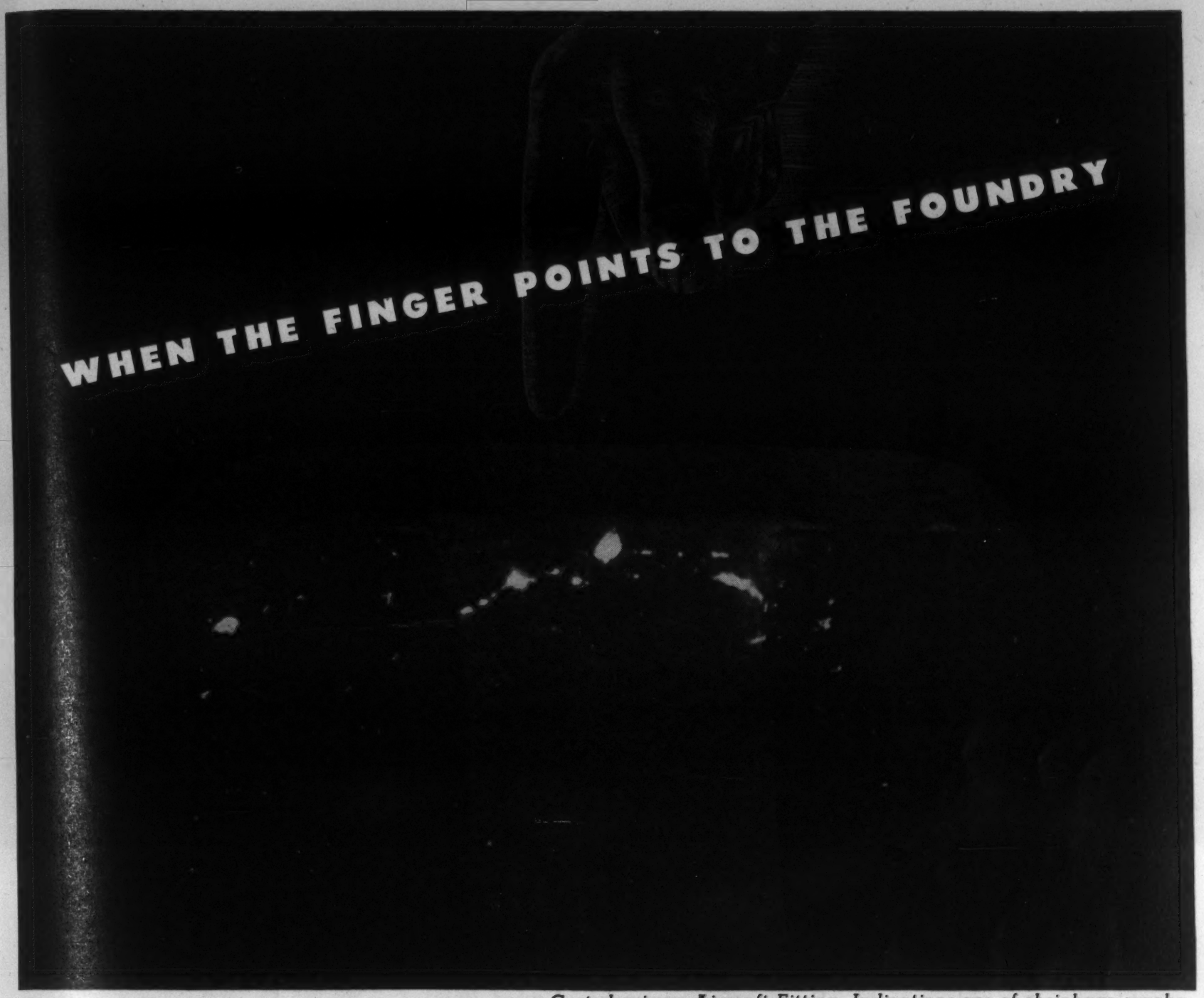
—V. M. Darsey. *ASTM Bulletin*, No. 128, May 1944, pp. 31-34.

Segregation in Aluminum-Silicon Alloys

Condensed from "Giesserei"

When melting silumin for die-casting, containing about 8% Si, to 0.6% Mn, and to 0.65% Fe, a heavy, very viscous lump is formed at the bottom of the melting pot that reaches a weight of about 7 kg. (15 lb.) in a day for a charge of only 300 kg. (660 lb.). This cake melts at about 900 C. (1650 F.), but segregates again in cooling between 800 and 900 (1470 and 1650 F.), and must be scrapped. The analysis of the cake showed an extraordinarily high Fe and Mn content as compared with the charge, *e.g.*, 8.5 Fe, 14.3% Mn.

Investigation of the reasons for the occurrence of this segregation led to the conclusion that Mn forms segregations in aluminum-silicon alloys at low melting temperatures, the magnitude of the segregation depending on temperature and manganese content. The formation of the cake means



Cast aluminum Aircraft Fitting. Indications are of shrinkage cracks.

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ZYGLO'S brilliant fluorescent indications allow the rejection of parts susceptible to failure. Often it is the means of correcting production operations to eliminate similar flaws in the future.

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loss of metal and increased wear of the melting pot.

In order to avoid these disadvantages, it is necessary in die-casting to maintain a sufficiently high temperature in the melt (620 to 670 C. or 1150 to 1240 F.) by the use of automatic temperature control, to use a manganese content of the aluminum-silicon alloy of about 0.2 to 0.7%, as even with 0.5% Mn and die casting temperatures above 630 C. (1170 F.) a considerable cake formation can take place.

The iron content of the silumin alloy should be as low as possible, as it was found that at 0.6% Fe, especially in presence of manganese, the iron is segregated. With iron contents of 1.5 to 1.8% (as provided in the German standard DIN-1744), cake formation cannot be avoided even with higher casting temperatures. Graphite crucibles must be used for melting to prevent increase of iron content in the melt by dissolving of crucible material.

The undesirable cake formation also offers, however, a possibility to purify aluminum-silicon alloys by tempering slightly above the melting temperature if they have been adulterated by iron and manganese.

—E. Meyer-Rassler & L. Laurs. *Giesserei*, Vol. 29, Oct. 1942, pp. 365-370.

"Black Light" for Inspection

Condensed from "Steel"

Fluorescence under ultra-violet rays has been used to supplement other inspection methods to reveal minute pores and cracks that are too small to be found otherwise. Applications include detection of shrinkage cracks and porosity in castings; cracks in carbide-tipped tools and lack of perfect bond between tip and shank; seams and cracks in tungsten rods for vacuum-tubes; cracks and pores in welds; and fatigue cracks in steel.

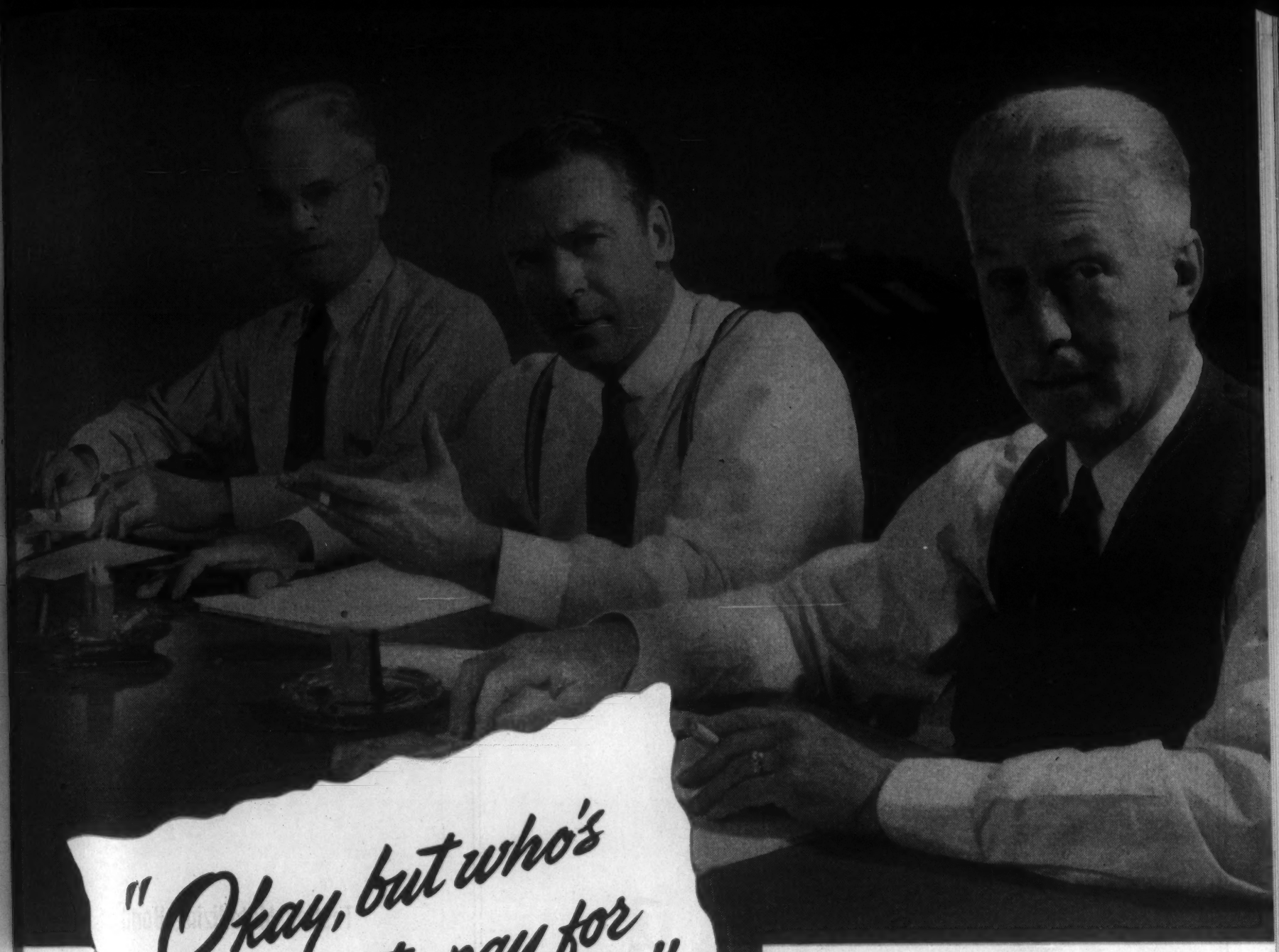
This method is now being used by the Cleveland Graphite Bronze Co., Cleveland, Ohio, for production inspection of aircraft-engine master rod bearings that are silver plated and steel backed.

In the "black light" department, the bearings are held for about 15 min. in a vapor-type degreaser, using tetrachlorethylene, where they are cleaned and heated to about 240 F., and any pores and small cracks are opened up.

Hot work from the degreaser is immersed in a treated Pennsylvania-type crank-case oil of medium viscosity, until the temperature of the bearings falls below 100 F. As the bearings cool in the oil, minute cracks and pores tend to close up tightly, trapping a certain amount of oil in them.

All oil is removed from the surface by first letting the work rest on a sloping drain board (much oil running off here) and then immersing the racks in succession in three tetrachlorethylene baths, which are purified continuously.

Final cleaning is done individually by lifting a bearing with a small pair of tongs padded with chamois, dipping it into tetrachlorethylene, and allowing it to dry on clean, heavy, lintless paper.



"Okay, but who's going to pay for the X-rays?"

That's a good question; and one which you may ask, or be asked, soon in considering your postwar operations. The answer is simply this—in industry, generally, radiography more than pays for itself.

In your particular business, the cost-balancing savings may be, for example, in machining where radiography eliminates man and machine time spent on defective parts—

. . . or it may be in your foundry in the determination of most efficient casting technics;

. . . or in assembly, or molding, or welding, or inspection;

. . . or it may be in the design of your product itself which might be lighter or simpler, or capable of being produced by more economical methods.

Your cost accountants can reduce these savings to dollars and cents. In addition, there are other, less tangible, benefits—

. . . the sales advantages of lighter, sounder, surer products;

. . . the maintenance savings resulting from better performance;

. . . and the greater general good will of your products, and your company.

To help radiography pay its own way, Kodak supplies a line of special films, solutions, and accessories . . . and offers the experience accumulated in 17 years of research in this field. Eastman Kodak Company, X-ray Division, Rochester 4, N. Y.

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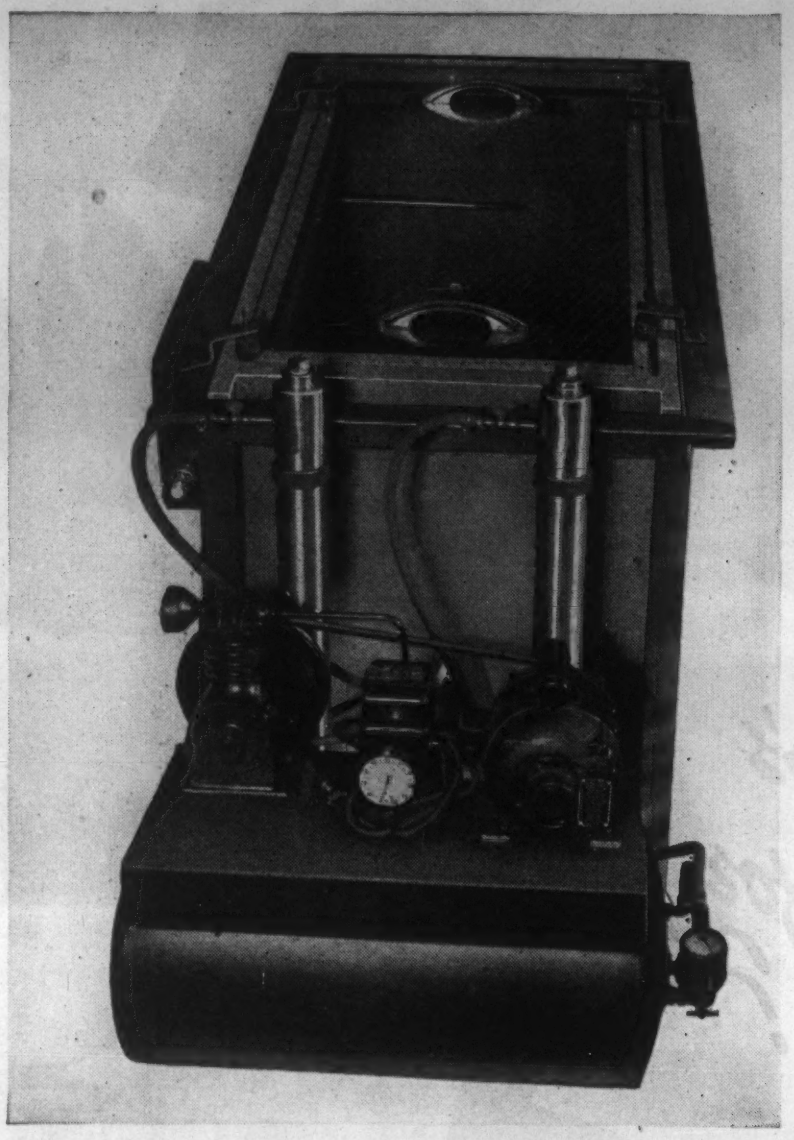
Salt Spray Testing Apparatus

Improved Fog-Test Model



This improved Spray Unit is recommended for producing Accelerated Corrosion Tests to simulate service behavior.

The serviceable life of electrodeposited articles can be determined by testing for corrosion resistance of base metal and permeability of the plated coating.

This method is conceded to be one of the most practical and dependable for inspecting specimens and ascertaining results as they would appear in outdoor exposure.

The Munning Improved Salt Spray Test consists of a Thermostatically controlled Salt Spray Chamber.

Two Washing Towers.
Air Compressor.
Storage Tank and Controls.

The Chamber is an inclined Alberene stone box, approximately 39½" long, 26½" wide, 25" deep, with water tight plate glass cover. Reinforced welded steel frame supports tank in position.

All internal metallic parts are of Monel construction; consist of Immersion Heater, Spray Nozzle and Thermometer Control Bulb.

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These Units are designed for flexibility. They meet varied specifications, and prove easy and economical to operate.

We will be pleased to furnish further details on our Improved Salt Spray Test Equipment. Write or 'Phone.

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Dry bearings are taken to a special "dark room" and loaded onto an electric hot-plate, where they reach 200 to 250 F. in 6 to 8 min. This allows the oil in the pores and cracks to work out to the surface without spreading too much over the surface.

The bearing is then held under the "black light" projector and rotated to bring all critical areas under the beam. Defects are indicated by a brilliant yellow-green glow.

A mercury-vapor lamp and a filter that passes only energy in a narrow band near 3650 Angstroms are used. This particular band is most efficient in causing the oil penetrant to fluoresce brilliantly under its excitation and is not injurious to the operators.

The most important use of this method is testing for poor bond between silver plate and steel backing. It is preferable to X-ray examination for this purpose and has replaced destructive tests on a certain percentage of work. One operator can easily inspect 100 of these bearings per hr.

The method can be used only to detect defects that have their origin at, or are connected to, the surface.

—G. W. Birdsall, *Steel*, Vol. 114, June 12, 1944, pp. 94-97, 156, 158-159.

Testing Metallizing Bond

Condensed from "The Welding Journal"

Standard testing procedures were developed for the metallizing industry so that consistent results can be predicted and can be compared on a uniform basis. The most common failures in metallized parts occur either on flat or nearly flat surfaces, or shafts that have been cut with a keyway.

The standard bond test shear specimen is cylindrical. The base metal is a bar, about 1 in. in diam., first machined throughout its length, also about 1 in. A tapered hole should be made in one end, and the piece mounted in the lathe on a tapered arbor for finish machining after spraying. A slot is then sawed completely through the sprayed coating into the base material.

A shear die block is prepared; then the specimen is placed in the block with the free end up and the pilot end in the die. The assembly is placed on the lower platen of a compression testing machine and the load applied. The shear strength can be computed from the known dimensions of the specimen and the readings of the testing machine.

In the tension testing procedure, the specimen consists essentially of a shaft made of mild steel, with a hole clear through it and perpendicular to its axis. A stud or plug of the base material to be tested is fitted in this hole, with one end flush with the surface of the shaft, and fastened by a set screw.

After spraying and bonding, the stud is pulled out of the shaft in a testing machine. With the dimensions of the shaft, coating thickness and stud diameter properly proportioned, failure of the bond takes place at the end of the stud. The coating does

This is how an electron behaves

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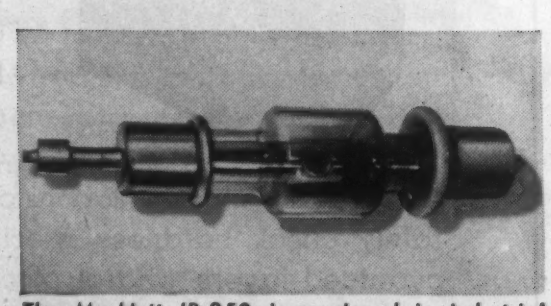
In designing a new electronic tube, mathematical calculations are invaluable, but as every designer knows, they are but preliminaries. After them, there usually come many tests of various experimental tubes. Machlett thought the cut-and-try method not only wasteful, but not productive of the best results. So we shortened and simplified the procedure by what our laboratory people call the "rubber model."

Here is a stretched rubber sheet. At the high end is a model of the cathode (electron emitter) of a proposed tube, and at the other end the anode, or target of an X-ray tube, plate of an oscillator or rectifier. The slope between the two is proportional to the desired potential difference. By means of an electro-magnet, a steel ball can be held in any position along the cathode, then released to roll under gravity to the anode, where the point it strikes can be observed and measured. *This is an electro-mechanical analogy.*

By means of this rubber model technique, months have been shortened into days, weeks into hours. More than that, new and higher performance has been achieved in the final product, so that when you buy a Machlett tube, you are assured of precise results, longer life, greater economy . . . Machlett Laboratories, Inc., Springdale, Connecticut.



The Machlett IR-250 is employed in industrial radiography and is an outstanding example of the X-ray tube art. Maximum capacity, 250 KV.

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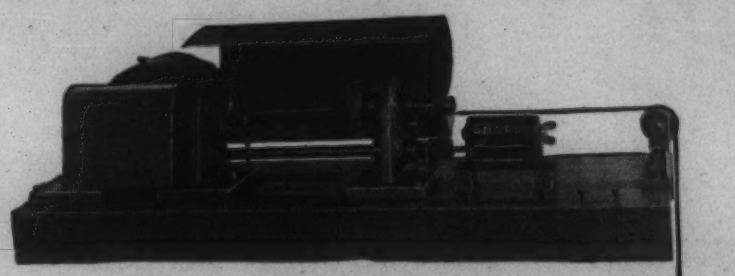
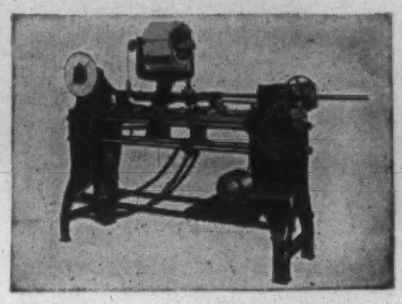


*Scott Tester Model T-3, illustrated above, is a new dual-rotation model which greatly accelerates the test. Specimens may be any length from 2″ to 8″. Various degrees of tension from ½ lb. to 17 lb. may be applied. The Scott line includes some 60 other models comprising machines for wires from finest filament to 1 ton, testing for tensile, hysteresis, flexing, compression-cutting of rubber covering, etc., etc.



Model Q-7 Scott Tester. Heavy duty tensile tester for wire with capacity of 2,000 lbs.

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not fail anywhere except at the destruction of the bond.

Before spraying, the plug should be replaced in the blank in the same previous position. A mask is applied to prevent sprayed metal from filling up the hole. The specimen is now sprayed in a lathe. The mask is unscrewed and the specimen machined to a diameter 0.170 in. larger than the diameter before spraying.

The specimen is then assembled in a test rig and mounted in a tension testing machine of at least 5,000-lb. capacity. Breaking load, as indicated on the testing machine, multiplied by 5.1, will give tensile strength of the bond in p.s.i.

Most bond failures are caused by internal stresses in the spray metal. The measurement of shear strength is most important as most of the internal stress is in shear. However, the two tests, tension and shear, must be considered together to give a true picture of bond strength.

—H. Ingham & K. Wilson. *Welding J.*, Vol. 23, May 1944, pp. 411-415.

Zinc-Aluminum-Copper Alloys

Condensed from "Giesserei"

The use of zinc alloys has now become commercially very important and many alloys, especially of the zinc-aluminum-copper type, have been developed. Their properties are, however, often quite different from those of aluminum alloys or brass, so that the zinc corner of the ternary system was investigated more closely.

These alloys, when freshly cast, change their volume quite considerably during storage at room temperature, and especially at somewhat elevated temperatures; a few minutes after solidification a shrinking occurs that can amount to 1.1% of the total volume. This shrinking stops after a few hours or days but is followed, particularly at higher temperatures, by an expansion that can last for months or even years and amount to 3.5 to 4%.

It was found that the reason for these changes was due to two processes: (1) The beta-disintegration, which is a division of a cubic-face centered phase into an aluminum-rich and a zinc-rich solid solution, and (2) a four-phase conversion in solid state in which three zinc-rich crystal types and one combination phase reaching far into the ternary take part.

The beta-disintegration leads to a reduction of volume with a maximum of 1.1%, while the four-phase conversion causes an increase in volume that can amount to 4%. Both increase and reduction of volume can be made harmless at the same time by drawing the alloys sufficiently long at 240 C. (460 F.); this reduces the change in volume to 0.1%. If, however, for special purposes a still better, *i.e.* smaller, change is desired, a second annealing at between 100 and 150 C. (210 and 300 F.) will reduce it to 0 to 0.05%.

—E. Gebhardt. *Giesserei*, Vol. 29, Nov. 27, 1942, pp. 397-403.

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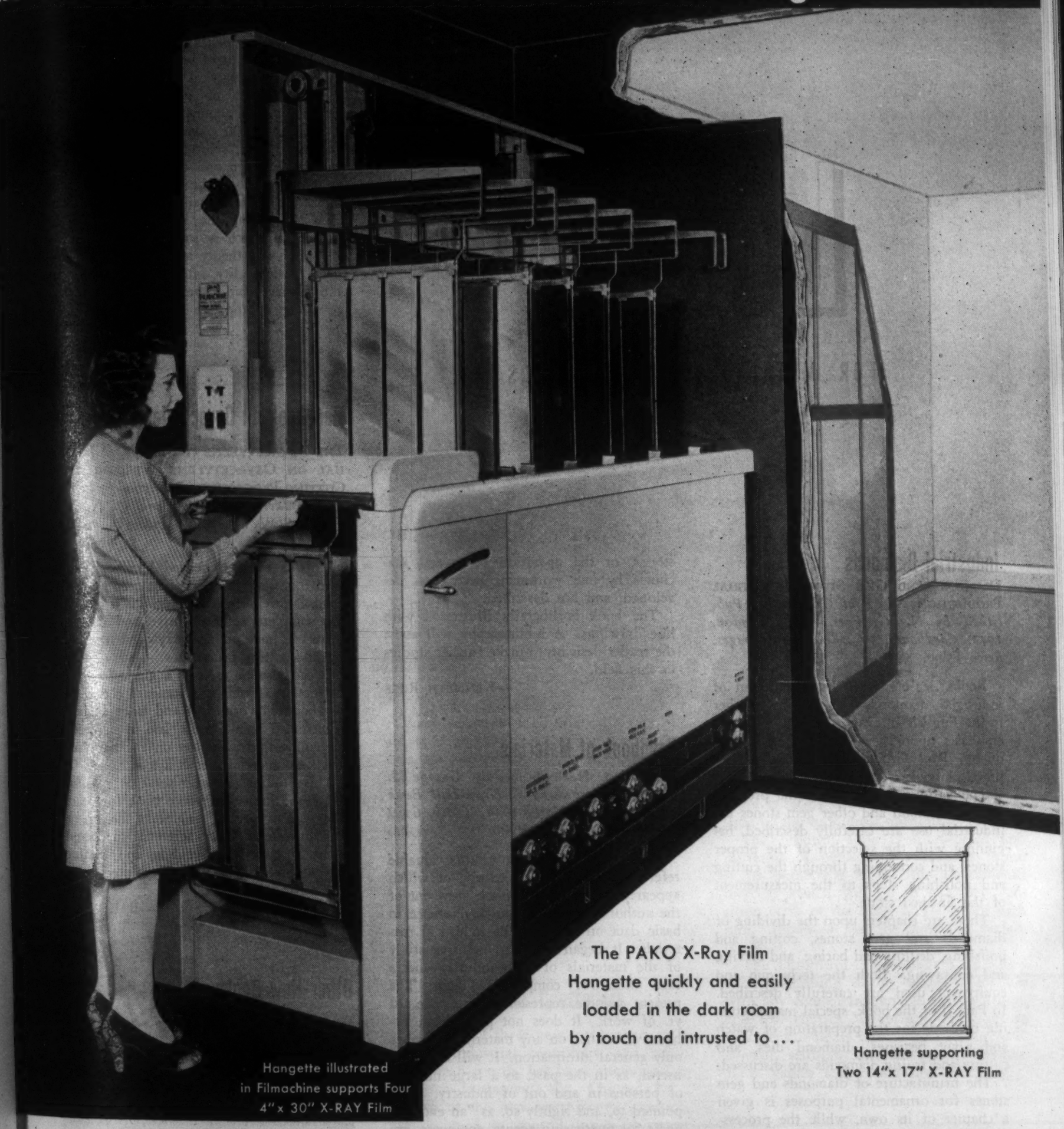

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books

FOR METALLURGICAL ENGINEERS

Industrial Diamonds

DIAMOND AND GEM STONE INDUSTRIAL PRODUCTION. *By Paul Grodzinski. Published by N.A.G. Press, Ltd., London, 1943. Cardboard, 5½ x 8½ in., 256 pages. Price $5.00.*

Books dealing with the preparation of industrial diamonds are few in number in the English language. With the present emphasis upon an American diamond industry, Paul Grodzinski's up-to-date and practical book is especially timely.

The various operations in the preparation of diamond and other gem stones for industrial use are carefully described, beginning with the selection of the proper stones, and continuing through the cutting and polishing steps to the measurement of the finished stone.

There are chapters upon the dividing of diamonds and gem stones, cutting and polishing, drilling and boring, and carving and engraving. Both the technique and equipment used are carefully described. In Part II of the book, special manufacturing methods for the preparation of watch and pivot bearings, diamond dies, and cutting and truing diamonds are discussed.

The manufacture of diamonds and gem stones for ornamental purposes is given a chapter of its own, while the processing of the hardmetals, such as sintered carbides, is given space in the concluding chapter.

Three appendices, one upon hard materials, the second upon cleaning and cleaning materials, the third giving conversion tables, add to the usefulness of the book.

As pointed out by the author, most of the operations in the manufacture of industrial diamonds are hand work, or done with the simplest of machinery. The work is still largely a matter of skill of the operator. A few time-saving innovations, such as the simultaneous working of several stones, or the operation of several machines by one workman, have been developed, and are described.

The book is liberally illustrated with line drawings. A bibliography will assist the reader desiring to make further studies in this field.

—KENNETH ROSE

Handbook of Materials

MATERIALS HANDBOOK. *By George S. Brady. Published by McGraw-Hill Book Co., Inc., New York,* 1944. *Cloth,* 6 x 9 *in.,* 765 *pages. Price* $5.00.

This is the fifth edition of this valuable reference book, the first edition of which appeared in 1929. This book grew out of the author's need for a quick reference to basic data on all kinds of industrial materials. It began with an intensive study of the materials of each industry and a card index of comparative data. The present volume represents more than 20 yr. of work. It does not provide an exhaustive treatise on any material but gives only general information. It will be found useful, as in the past, to a large number of persons in and out of industry. It is pointed to, and rightly so, as "an encyclopedia for purchasing agents, engineers, executives, and foremen."

—E.F.Cone

Metals and Their Heat Treatment

PRACTICAL METALLURGY FOR ENGINEERS. *Fourth Edition. Published by E. F. Houghton & Co., Philadelphia, Pa., 1943. Cloth, 8¾ x 6 in., 470 pages. Price $3.00.*

Despite the fact that this book is published by a commercial manufacturer of metal working chemicals and might therefore be expected to do more subtle selling than educating, it is one of the best simple treatises on the heat treatment of steel available.

Its 400-odd pages contain a truly remarkable amount of well-organized, clearly explained, practical information on the heat treatment of metals (about 300 pages) with a somewhat less useful section (about 100 pages) on their manufacture. The "selling" is brought right out in the open and confined to 4 pages near the end of the book. There are about 40 pages of engineering reference data comprising the last chapter.

The approach is practical but the explanations of theory are clear and up-to-date, hardenability, interrupted quenching, the S-curve and other modern concepts receiving appropriate attention.

—FRED P. PETERS

Handbook on Oxyacetylene

THE OXYACETYLENE HANDBOOK: A MANUAL ON OXYACETYLENE WELDING AND CUTTING PROCEDURES. *Published by Linde Air Products Co., New York 17, N. Y., 1943. Cloth, 6½ x 9½ in., 587 pages. Price $1.50.*

This is a much needed handbook—up until this time "there has not been a really good gas welding text book." It is offered as a complete, comprehensive, and authoritative text book on basic oxyacetylene welding and cutting procedures.

It can also be used as a guide for self-instruction as well as a standard classroom text book in vocational and trade schools in technical high schools, and in engineering colleges. Instruction on the handling of all commercial metals are included.

This volume can also serve as a guide and authoritative reference book for plant management people, engineers, designers, superintendents and foremen in shops where oxyacetylene welding and cutting are employed. The book is pointed to as a "how-to-do-it book."

—E. F. CONE

Other New Books

ALLOY CAST IRONS, SECOND EDITION. *Published by the American Foundrymen's Association, Chicago,* 1944. *Cloth,* 6 x 9 *in.,* 282 *pages. Price* $3.25. The second and revised edition of this book follows substantially the pattern of the first edition, published in 1939. The typography has been changed and improved, and minor additions to several of the discussions have brought them up-to-date. An improved arrangement of the bibliographies on each subject is to be commended—each one is now inserted after the subject to which it refers instead of in the back of the book. Chapter 3 has been substantially enlarged with added text and some new illustrations. A chapter on Ladle Inoculants has been added. The generl value of the volume has been enhanced.

LUBRICANTS AND CUTTING OILS FOR MACHINE TOOLS. *By William G. Forbes. Published by John Wiley & Sons, Inc., New York,* 1943. *Cloth,* 5¾ x 8¾ *in.,* 90 *pages. Price* $1.50. A handy and practical little book for the machine shop man is this one by W. G. Forbes. Lubricants and cutting oils are described in brief fashion, with standard laboratory tests for their evaluation. The book gives good, usable information about lubricants, but is less specific about recommendations for cutting compounds. Brief outlines of metal cutting tool types and processes are included as guides to selection of cutting oils, and the various treated oils, such as sulphurized and chlorinated types, are discussed.

METALLURGICAL ENGINEERING news

Equipment • Finishes • Materials • Methods • Processes • Products
Alloys • Applications • Designs • People • Plants • Societies

Four-Range Comparator

A new comparator, with so wide a range of magnification that it can do the work formerly required from as many as four standard comparators, is being offered by *Continental Machines, Inc.*, 1301 Washington Ave., South, Minneapolis 4. Each "Doall" comparator has four magnification ranges. Thus, size variations from one-millionth in. to four-thousandths of an in. may be checked.

Variable pressure adjustment provides exact pressure needed for measuring thick or thin sections, or hard or soft materials. Spindle pressure is adjusted by a calibrated dial at the top of the unit. The spindle movement is magnified electrically, thus

assuring exact repeat readings, since there are no moving parts to stick or bind.

The gage head swivels 360° in horizontal and vertical planes, making it easy to check irregularly shaped parts or multiple jig fixtures.

Both the work anvil and calibrated dial are at equal distances from the operator's eyes, making it easy to insert work under the spindle and read the indicating pointer. Three models of the comparators are offered, each having four ranges of magnification.

Industrial Controllers

Addition of three new instruments to its line of industrial controllers, and refinements in a fourth, has been announced by *Wheelco Instruments Co.*, Chicago 7.

Two of the new instruments, Inputrols, are designed to control input of power, heat or flow of liquids or gases to any process equipment. The third, a Throttltrol, is designed to correct variations in heat requirements of furnaces and process equipment by positioning a valve in the fuel line.

The company's Rheotrol, a manually-operated controller for regulating input to electrically operated furnaces, ovens, heaters, kilns, etc., has been refined and is now offered in a flush-mounted case.

Inputrols are offered in automatic and manually set models. The basic elements of the instruments are a mercury switch mounted on a carriage, a rotating horizontal cylindrical cam driven by a small synchronous motor, and a spiral on which the mercury switch carriage is mounted.

In the automatic model, which is used with a pyrometer, the spiral is turned automatically to position the mercury switch carriage at the proper point along the rotating cam. In the manual model, the spiral is set by hand to the input point desired by the equipment operator.

The Inputrol scale is illuminated and in terms of percent of maximum input. If its pointer is at 60, the instrument's mercury switch will be in its "ON" position 60% of the time, or 36 sec. of each min. Inputrols may be flush or surface mounted.

The Throttltrol is essentially a simplified valve-positioning devise designed for use with any control instrument having a high and low contact. It corrects variations in heat requirements due to changes in load, control settings, air and fuel pressure, B.t.u. values and combustion efficiency.

● Difficulties of securing and tanning walrus hides for polishing metal surfaces have been overcome. A new method of tanning produces especially long-wearing, tough, flexible leather for polishing wheels or bobs. The close, firm grain results in a lustrous and durable mirror finish. It is furnished in any thickness from ½ in. to 1¼ in. for any size wheel or bob by *Greene, Tweed & Co.*, 4377 Bronx Blvd., New York 66.

These Alloy Rabble Arms Do Not Grow or Scale; *Blades Are Easy to Replace*

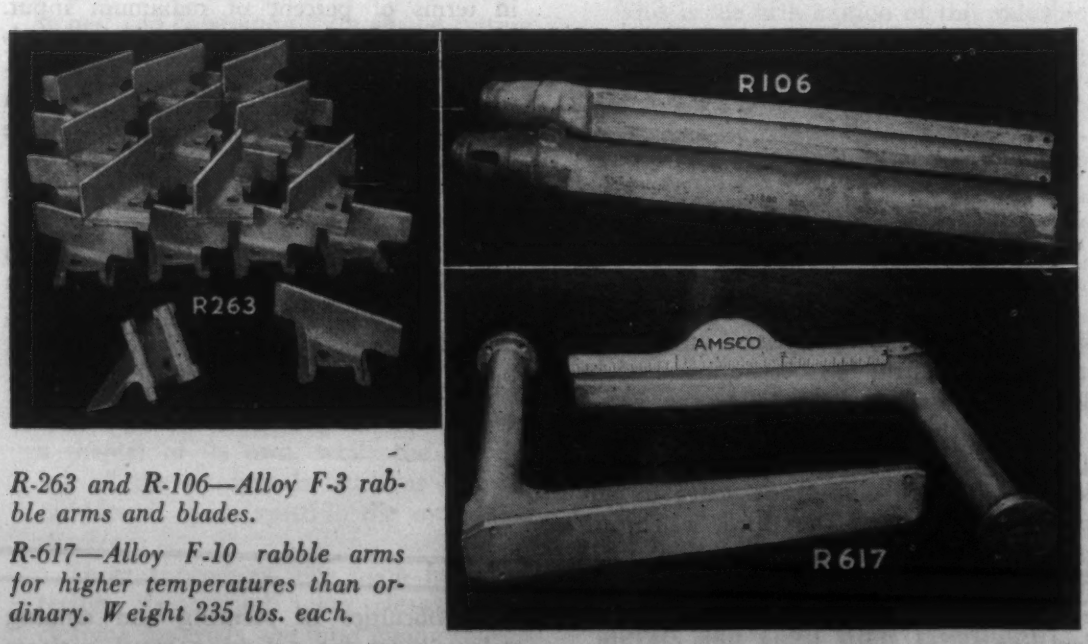
The various processes carried on in modern multiple-hearth roasting, calcining and drying furnaces call for the continuous application of heat and the stirring or "rabbling" of the material. The rabble arms and blades used for the stirring operation are exposed to temperatures which are not excessively high, ranging from 900° to 1800° F., but they are higher than ordinary iron will resist over long periods. Too, corrosion arising from sulphurous gases and severe abrasion have a very destructive effect on anything but a properly selected chromium-nickel alloy.

Amsco Alloy F-3, containing 27 to 29% chromium and 0 to 3% nickel, is almost universally economical in roasting practice. Some rabble arms are cooled by the air which is passed through them, not primarily for cooling purposes but for preheating purposes. It is not necessary to cool Amsco Alloy rabble arms, and the useful service life of non-cooled Amsco arms is no less than that of those which are cooled.

Where temperatures are on the high side and greater strength is required to prevent sagging, arms of Amsco Alloy F-10 (26-28% chromium and 10-12% nickel) are recommended. At a zinc-roasting operation a decided improvement was effected by this change in analysis.

It is seldom reported that an Amsco Alloy rabble arm, blade or tooth has broken in operation; and the service life despite heat, corrosion and abrasion is usually many times that of cast iron. Because this chromium-nickel alloy does not "grow" in service, the rabble blades not only last longer but are easier to replace, cutting down delays and labor costs.

Ask for Bulletin 108.



R-263 and R-106—Alloy F-3 rabble arms and blades.

R-617—Alloy F-10 rabble arms for higher temperatures than ordinary. Weight 235 lbs. each.

Advantages of Amsco-Nagle Centrifugal Pumps described in Bulletin 940.

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois

AMERICAN Brake Shoe COMPANY

FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

Lead Alloy Coating Technique

A new hot dip lead alloy coating technique is announced by the *National Lead Co.*, 111 Broadway, New York. These low tin content alloys are suitable to all hot dip processes now in use. They show excellent wetting properties, uniform coating characteristics, low melting points, good fluidity, minimum dross and excellent working properties.

The alloys harden with age, increasing from 12 to 20 Brinell after two or three days at room temperature. Elongation approximates 39% in tensile tests. Whereas the tensile strength of lead is 1800 p.s.i., that of the new low tin lead alloy, No. 560, is 6500 p.s.i.

By using National Lead's DW flux, one can use lead alloys containing as low as 2½% tin or less, with small amounts of other metals, without any decrease in its wetting and bonding characteristics. The melting point of this flux can be controlled over a range of 400 to 800 F., being packaged according to its temperature rating, the most commonly used having a liquidus of 468 F.

After the conventional cleaning, etc., the coating operation consists of immersion of the article in the molten metal, with sufficient agitation to assist in the freeing of adhering flux. After dipping, the coated articles may be cooled in air, or quenched in oil, the latter technique resulting in more even and finer grained coatings.

The coating of sheet, using DW flux and these new low tin-lead alloys, can be readily carried on in the present terne or galvanizing coating units. Coating weights as low as 0.2 oz. per sq. ft. (both sides) may be had.

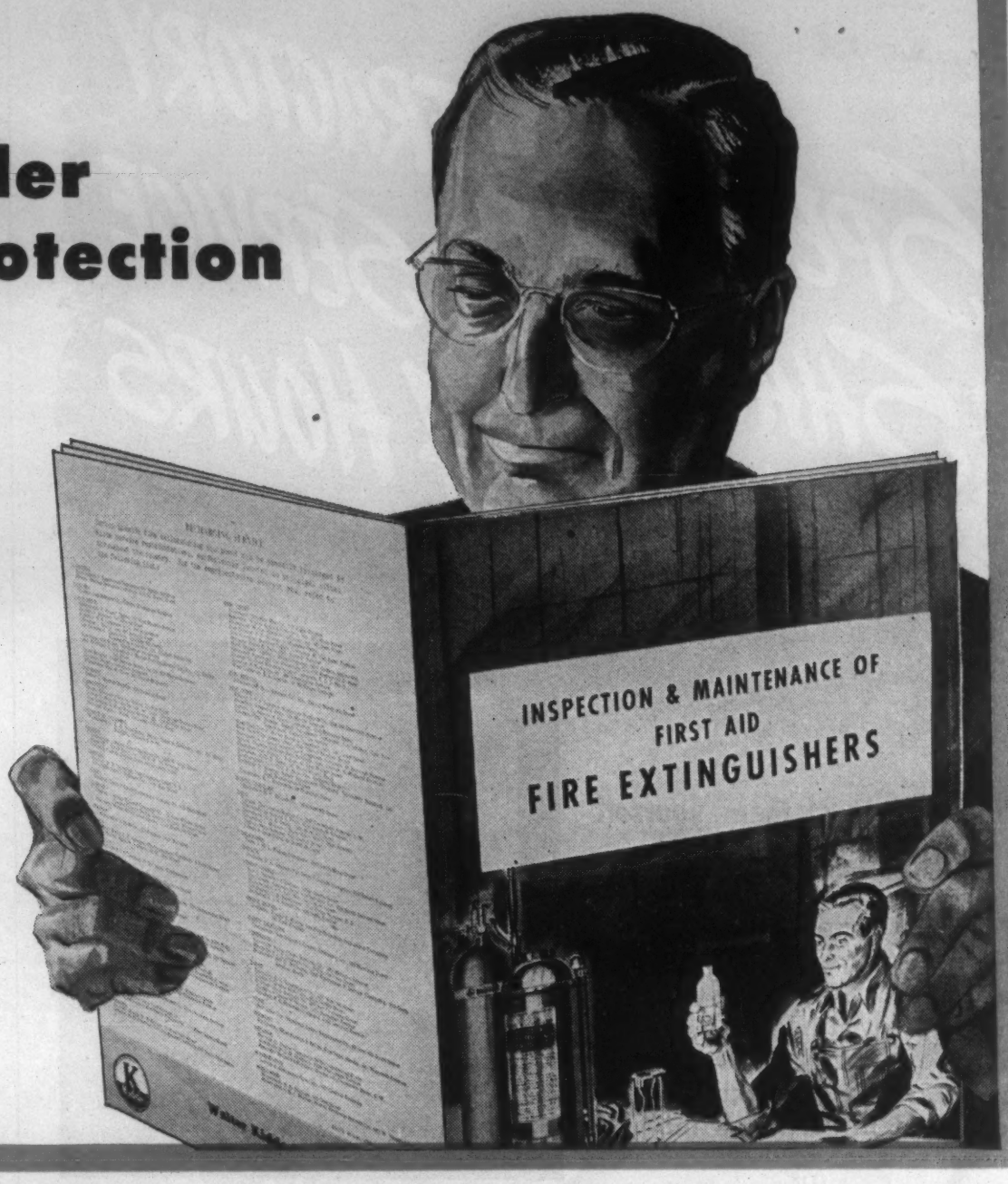
On exposure to the atmosphere there is formed, particularly where pin holes exist, a relatively insoluble protective film of the alloy and iron content of the steel, due to the formation of a lead-iron oxide compound. The film is self-healing and prevents any further attack by the atmosphere.

The small amounts of tin and other metals in the lead alloy tend to impart a marked increase in abrasion resistance. Where small parts, such as bolts and nuts, are subjected to the process, the smooth even lead alloy coating acts as a gasket and provides a tighter fit.

Fuel consumption is low, the baths do not dross much, and there is a negligible alloy attack on the vessels, making for minimum pot replacements.

● A low-cost universal device for stamping numbers and letters on round shafts is put out by *New Method Steel Stamps, Inc.*, 147 Jos. Campau, Detroit 7. It consists of a single vee block that holds the stamping device, using solid or interchangeable type, and automatically centers the stamps on the O.D. of the bar being marked. A knurled stud, held tight by a flat spring, fits into a slot in the shank of the solid stamp or type holder. The stamp has proper vertical play but is kept firmly in line. A knurled handle permits the shaft marker to be held firmly in place.

First reader in fire protection



Free book tells how to keep extinguishers in fighting form

Make sure *your* fire-fighters will always be ready to nip blazes before they get out of hand. Regular inspection is the only safe way.

This new book, issued by Walter Kidde & Company, will help you set up your own maintenance system. It covers all types of equipment, gives exact instructions for examining and re-charging. Write for your free copy today! Just ask for "Inspection and Maintenance of First Aid Fire Extinguishers."

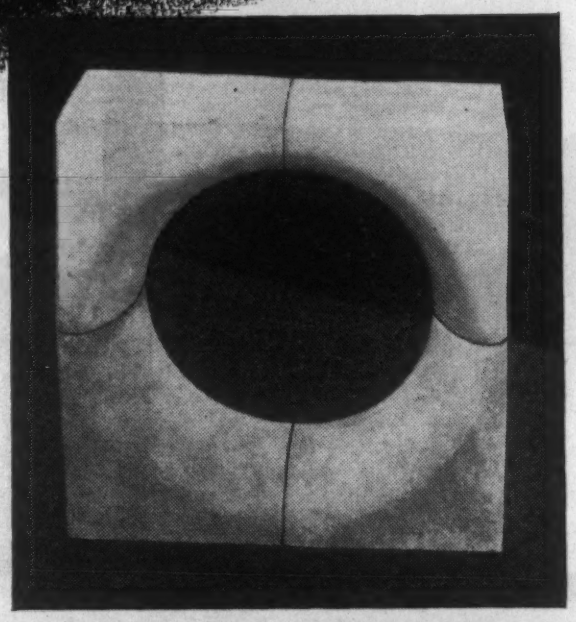
CHAPTER HEADINGS INCLUDE:

- WHO'S IN CHARGE?
- KEEPING RECORDS
- MARKING THE EXTINGUISHERS
- INSPECTION OF EXTINGUISHERS
- VAPORIZING LIQUID EXTINGUISHERS
- CARBON DIOXIDE EXTINGUISHERS
- SODA-ACID EXTINGUISHERS
- FOAM EXTINGUISHERS

Kidde

WALTER KIDDE & COMPANY, INC., 140 CEDAR STREET, NEW YORK 6, N. Y.

SPECIAL REFRACTORY SHAPES - IN SERVICE WITHIN 24 HOURS

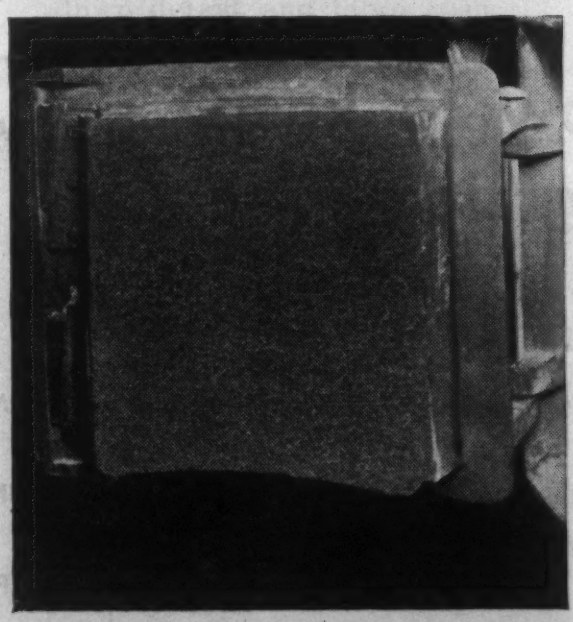


When you cast them yourself with J-M FIRECRETE

GUARD against costly, production-delaying shut downs by casting special refractory shapes in your plant with Johns-Manville Firecrete. These shapes can be made easily and quickly . . . and be placed in service within 24 hours.

J-M Firecrete is handled like concrete. Ideal for furnace covers and bottoms, door linings, baffle tile, burner rings and other types of monolithic refractory construction. Hardens quickly, has negligible drying and firing shrinkage. Highly resistant to spalling.

Three types—Standard, for temperatures to 2400° F; H.T., for temperatures to 2800° F; L.W. (light weight, low conductivity), for temperatures to 2400°F. Write for folder RC-13A. Johns-Manville, 22 E. 40th St., New York 16, N. Y.



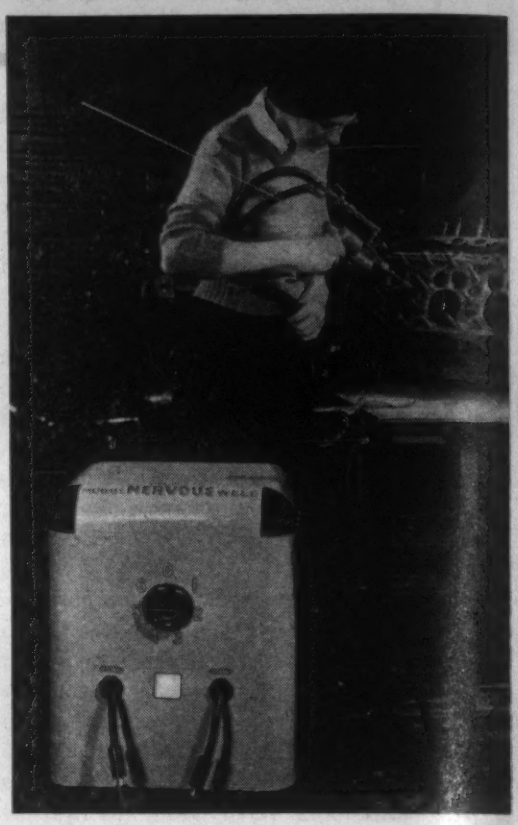
JM PRODUCTS

Johns-Manville **FIRECRETE**

The Standard in Castables

Weld Pistol for Reclaiming Castings

To reclaim defective aluminum castings and to salvage bronze, gray iron, and malleable and steel castings, the *Metallizing Co. of America,* 1330 W. Congress St., Chicago, has developed the Mogul Nervous Weld Process. Other important uses are the building up of surfaces for press fits,



repair of cracked housings, motor blocks, pump housings and preparation of surfaces for metallizing.

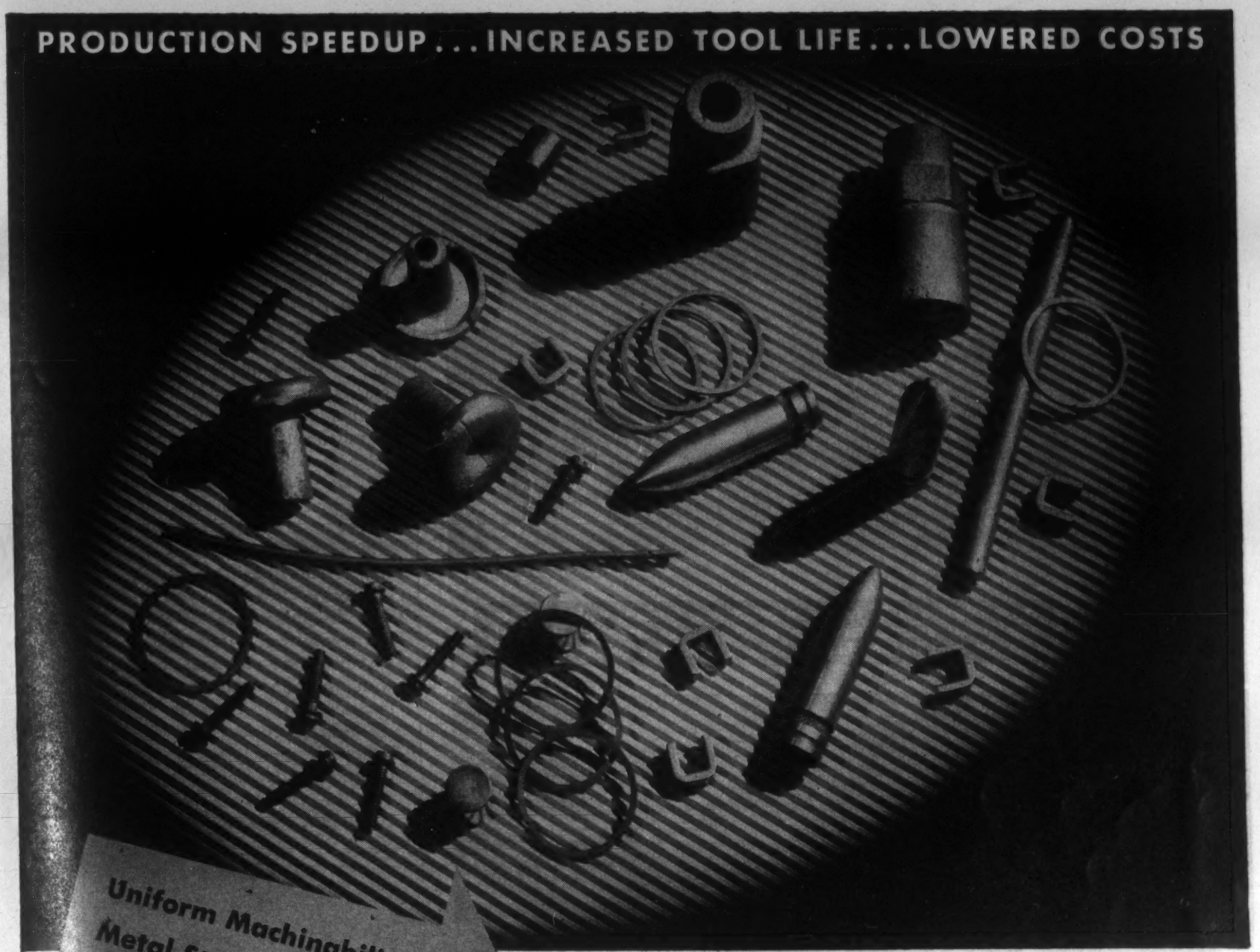
Prominent among the equipment are the pistol that requires 60 lb. of air pressure at 4 to 5 cu. ft. per min.; and the weld machine, 110, 220, 440 volts, 60 or 25 cycle, single phase.

The pistol deposits atomized particles of metal, which are welded to the surface and pressed, leaving a metal that is welded and forged. Aluminum, bronze or nickel rods are fed through the pistol by a trigger control, feeding ⅛ to ⅜ in. with one stroke of the trigger.

The process eliminates stresses and distortion in the repair of aluminum castings. The temperature never rises above 125 F., yet provides a deposit so dense at the point of fusion that there is no apparent line of demarcation.

Aluminum castings, repaired with this unit, machine perfectly and withstand sodium hydroxide solutions used to prepare castings for alumilite plating.

● Steel ribbons are now used to reinforce the standard thumb and two finger guard of chrome leather, a sort of semi-glove, for punch press operators and employees handling sharp, jagged small castings, stampings, etc. It is steel stitched, and held on the hand by a quick-adjustable strap at the wrist. It is made by *Industrial Gloves Co.,* Danville, Ill.



Uniform Machinability of Metal Stock for Such Pieces Insured in 100% Non-destructive Inspection by the . . .

DuMONT *Cyclograph*

If you are buying or selling metal stock which is to be machined in automatic high-speed equipment, you will be interested in some of the *non-destructive* tests which can be done with the Cyclograph.

This instrument can be used to insure that *all* pieces going to an automatic lathe or other equipment are *reasonably uniform in machinability*. Pieces which are too hard may be rejected, re-treated, or run on slower machines with appropriate tooling.

The Cyclograph has successfully performed this service, but since machinability is a very complex quality, we must investigate any new problem of this type before recommending the use of the Cyclograph in such an application.

Submit Your Problem . . .

Send us that problem. We shall give you a detailed Engineering Report on the feasibility of using the Cyclograph in your plant. The savings in tool life and time alone which may be possible with this 100% non-destructive inspection, make it worth your while to investigate. Literature on request.

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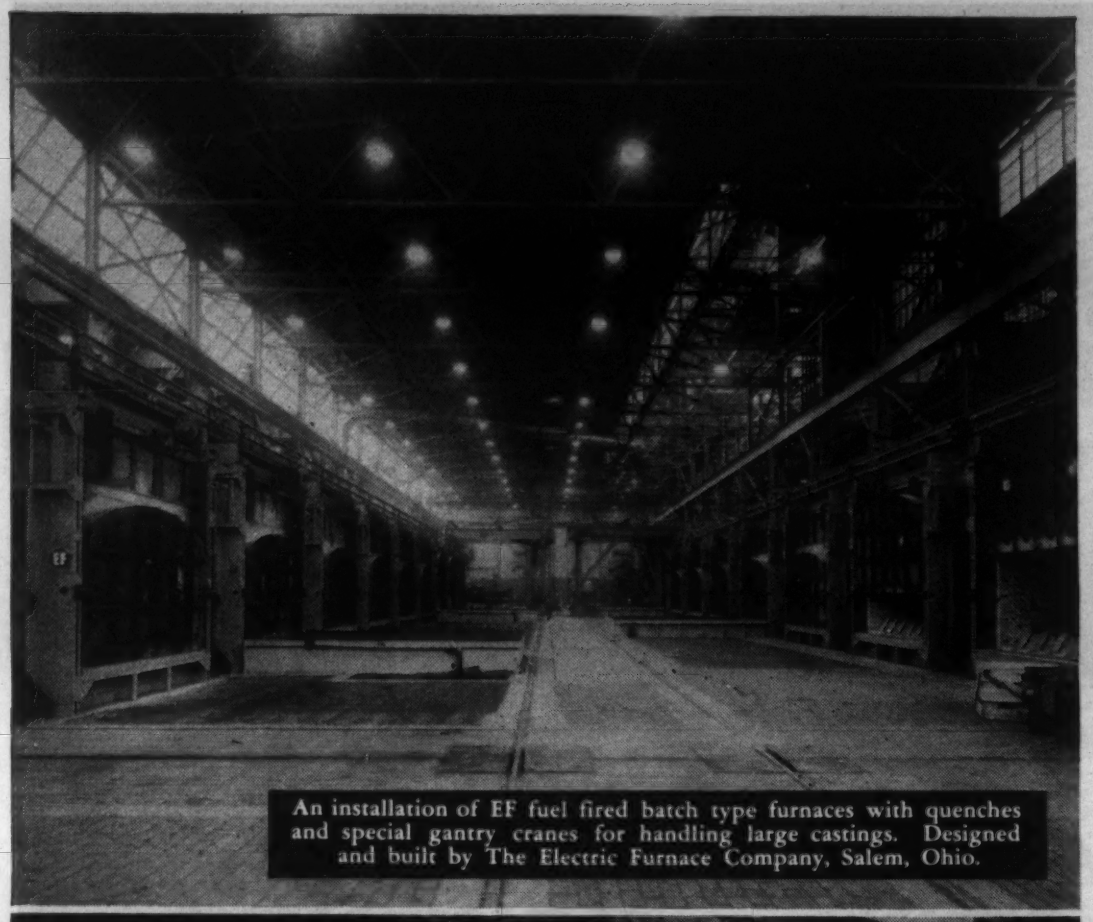
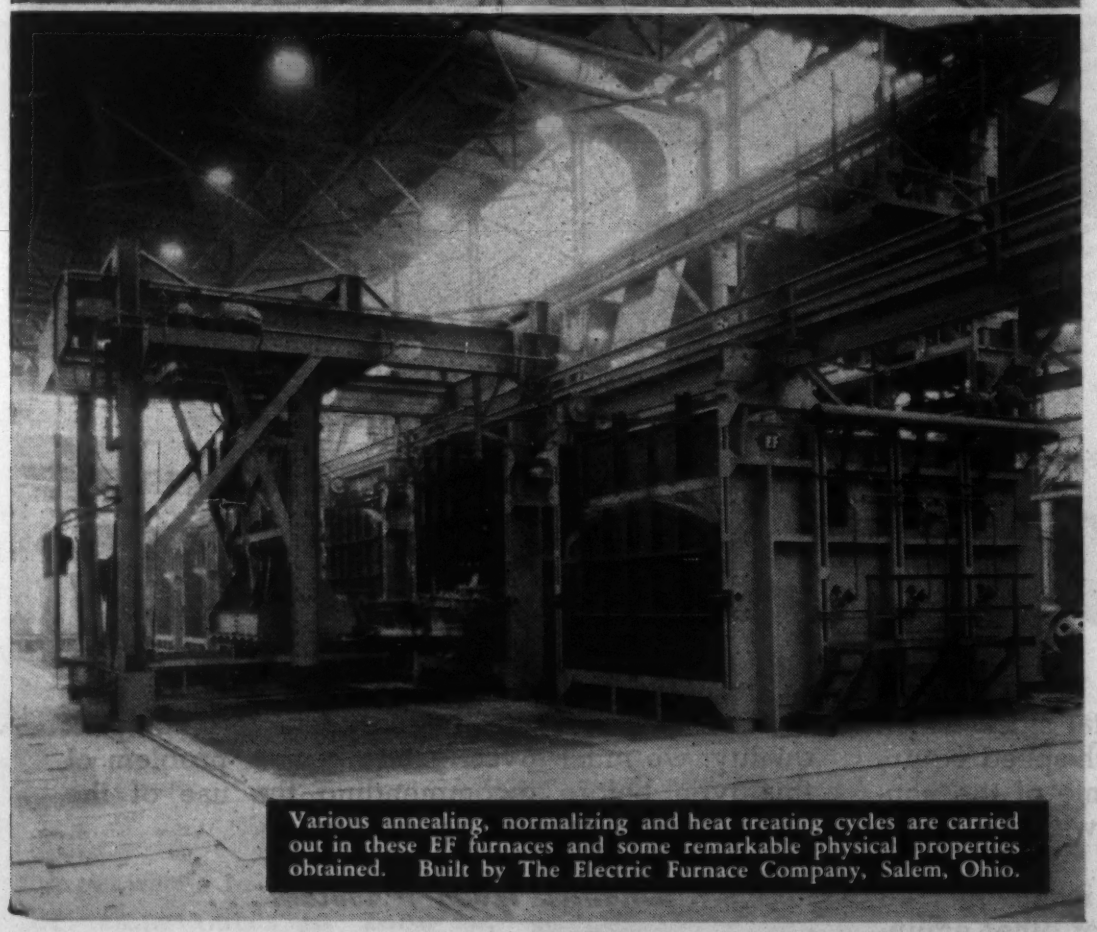
DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC NEW JERSEY • CABLE ADDRESS: WESPEXLIN, NEW YORK



An installation of EF fuel fired batch type furnaces with quenches and special gantry cranes for handling large castings. Designed and built by The Electric Furnace Company, Salem, Ohio.



Various annealing, normalizing and heat treating cycles are carried out in these EF furnaces and some remarkable physical properties obtained. Built by The Electric Furnace Company, Salem, Ohio.

FURNACES OIL, GAS or ELECTRIC

For Every Heating and Heat Treating Process

Aluminum Brazing	Carburizing	Nitriding
Annealing	Drawing	Normalizing
Billet Heating	Enameling	Soaking Pits
Bright Annealing	Forging	Scale-Free Hardening
Bright Hardening	Hardening	Quenching Machines
Copper Brazing	Malleablizing	Ceramic Kilns, etc.
Controlled Atmosphere	Silver Soldering	Process Heating

We Build the Furnace to Fit Your Job

THE ELECTRIC FURNACE CO.

SALEM, OHIO

X-Ray Diffraction Unit

A new X-ray diffraction unit has been perfected that does the job in a non-destructive manner and is useful in the metallurgical, chemical and scientific fields. The sponsor is the *North American Philips Co.*, 100 E. 42nd St., New York 17.

This unit can be used with the new Philips low-angle-scatter camera or other standard types of cameras. The new equipment will prove invaluable in welding, casting, forging, plastics, steel valves, high pressure tanks, etc.

The new "Norelco" X-ray diffraction unit has a four-windowed tube enclosed in a massive bronze housing. Diffraction patterns of four different specimens can be obtained simultaneously. A number of types of X-ray tubes can be provided, included in which are targets of tungsten, molybdenum, cobalt, iron, chromium and copper.

The unit utilizes full wave rectification, which permits higher output and longer life. Filament current supply is stabilized, control of kilovoltage and milliamperage is smooth and stepless. The tube is protected automatically if water supply fails.

Among the problems that can be solved with the diffraction unit are: Chemical identification of materials, phase analysis in chemical processes, presence or absence of preferred orientation in metals or fibers, particle size determination of fine materials, such as catalysts, carbon blacks, rubber fillers, etc.; the goniometric data of crystals, etc.

● A new pure white, edible glyceryl monostearate in bead form that is completely dispersible in hot water is announced by the *Beacon Co.*, 97 Bickford St., Boston. Called "Bemul," it has many uses, including a protective anti-oxidant coating for metals.

Broach Sharpener

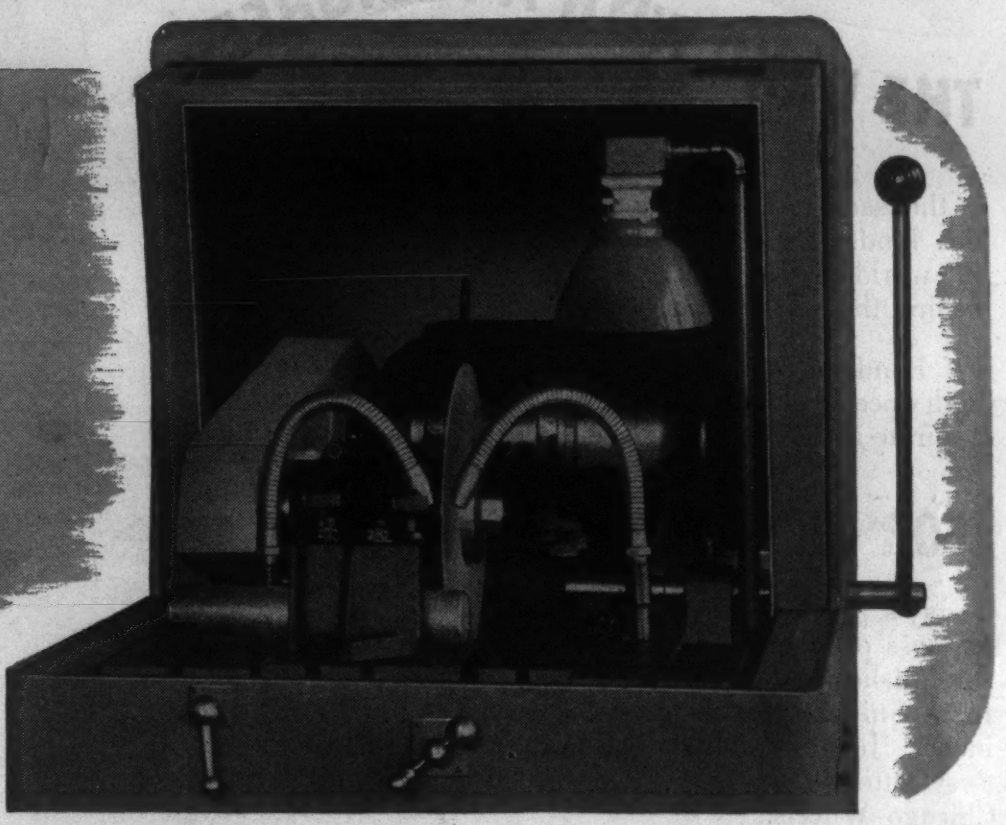
A new broach sharpener, adapted for women operators and providing for the increased sizes of broaches used these days, is announced by *Colonial Broach Co.*, Box 37, Harper Station, Detroit 13. Known as model CS2, it is designed to handle virtually any broach in use, such as round and flat, spline and serrated; from the smallest up to 7 ft. long and 6 in. diam., with 8 in. maximum width for flat broaches.

An important feature is the lightweight alloy construction of the sliding head, weighing one-third that of iron or steel. It is supported and guided on by full anti-friction double-row rollers. All bearings are sealed against entry of grinding dust.

The changeover from sharpening round to flat broaches is accomplished conveniently without special tools and with but few adjustments. Universal positioning and movement of the grinding wheel are obtained by a vertical column, cross slide mounted on a graduated cross slide support and a graduated wheel head mounting.

Buehler ABRASIVE CUT-OFF MACHINE

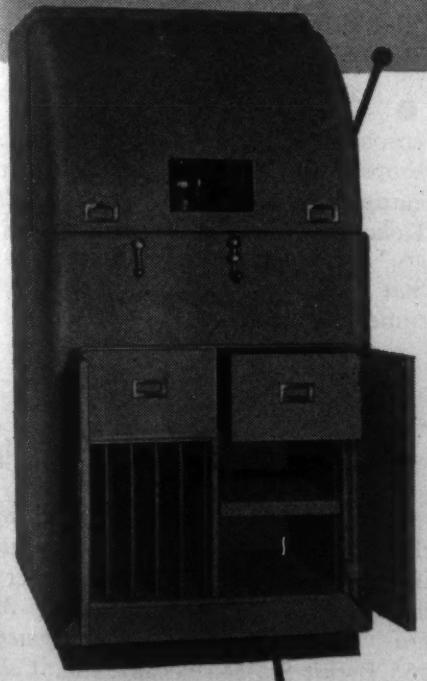
...for the Metallurgical Laboratory



Completely enclosed — full protection for the operator

Fast cutting

Smooth operating



Model 1000

The Buehler Cut-off Machine No. 1000 is a solidly built heavy duty machine free from vibration and side play with capacity for cutting specimen sections up to 3½".

Cutting is done on the front of the wheel and is controlled by a convenient outside lever. With the cover closed, the cutting operation can be viewed through a heavy wired glass window. Regular equipment includes 3 HP totally enclosed ball bearing motor 1750 r.p.m., 220 v., 60 cycle, AC, 3 phase; pump motor ¼ HP, 220 v., 60 cycle, 1 phase; six cut-off wheels 12"x3/32"x1¼". Wheels not in use are stored in a spacious compartment in the base, which also contains a removable sludge collection chamber. The self-contained cooling system provides a flood of water for cool cutting. Overall dimensions 31"x47"x64". Shipping weight 1400 pounds.

The Buehler line of specimen preparation equipment includes . . . .
CUT-OFF MACHINES • SPECIMEN MOUNT PRESSES • POWER GRINDERS
EMERY PAPER GRINDERS • HAND GRINDERS • BELT SURFACERS
POLISHERS • POLISHING CLOTHS • POLISHING ABRASIVES

Buehler Ltd.
A PARTNERSHIP

METALLURGICAL APPARATUS
165 West Wacker Drive, Chicago 1, Illinois

THE BOND WITH A PEDIGREE..

Chicago FV

A thousand test formulas—hundreds of bonds of various kinds—fifty years experience making bonds for the world's best grinding wheels— this is the Pedigree behind the new FV Bond.

FV Bond holds wheel shapes firm even when run at high speed, and produces a satin-like finish that is so accurate it passes any surface analyzer test hands down.

FOR THAT PERFECT FINISH

Today's precision instruments and tools as well as mass production of war equipment parts, call for finishes with closer tolerances than ever before—finishes that can be measured in micro inches. Just any old wheel won't do. That's why this better bond—FV—was developed for all Chicago Wheels.

There's a best grain, grade, size and shape wheel —all made with FV Bond—for each kind of material to be finished—a whole army of Chicago Wheels at your service.

CHICAGO MOUNTED WHEELS

All the most needed shapes, each mounted firmly on its own steel shank to last as long as the wheel itself.

CHICAGO GRINDING WHEELS

For the duration, with full WPB approval, we are specializing on sizes up to 3" in diameter only.

TRY ONE! It's the quick way to find out about FV Bond. We'll make it easy for you by sending, without charge, any size you specify to fit any grinder.

FREE ENGINEERING ANALYSIS

★ Half a Century of Specialization has established our reputation as the Small Wheel People of the Abrasive Industry.

Some of the new metals, alloys and laminates present real grinding problems. If you have a job that stumps you, our experts will work with you to determine the best wheel to give the job *that perfect finish* in the quickest time.

Write for Catalog & Engineering Survey Form

CHICAGO WHEEL & MFG. CO.

1101 West Monroe St. Dept. ME Chicago 7, Ill.

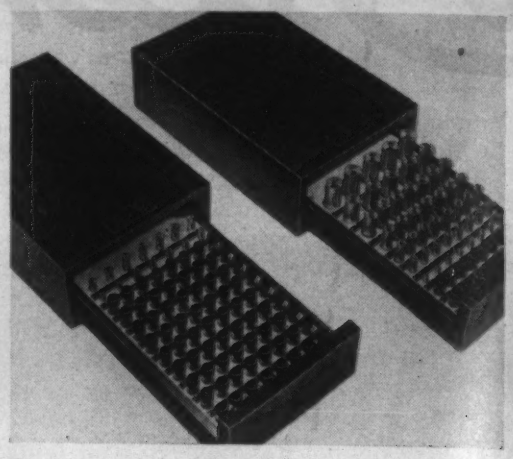
ME-8

Send Catalog and Survey Form. Interested in:
☐ Grinding Wheels. ☐ Mounted Wheels.
☐ Send Test Wheel. Size.....
Name .....
Address .....

Precision Pin Sets

Strong compact cabinets, completely furnished with precision pin sets for gages, in number drill, letter drill and fractional sizes, are announced by *United Precision Products Co.*, 3524 W. Belmont Ave., Chicago 18.

Number drill sizes, 1 to 60; letter drill



sizes, A to Z (86 pins), and fractionals, 1/64 in. to 1 in., in increments of 1/64 in. (64 pins) are of the finest quality gage steel, hardened to 60-63 Rockwell C and finished to ultimate accuracy.

Brass strips, with letter, number or fractional, permanently fixed in clear, easily read white, identify each gage at its position. The smaller pins are in glass vials with heavy plastic screw tops and felt cushions at the bottom.

When requesting price estimates, gage users are requested to specify tolerances desired.

● Tool tips cast from Stellite cobalt-chromium-tungsten alloy are available for shops desiring to fabricate their own metal-cutting tools, states *Haynes Stellite Co.*, Kokomo, Ind. Ten standard shapes of tips are available, cast from either 98M2 or Star J-Metal alloy. Joint faces are bronze-tinned for brazing.

Monorail-Spray Metal Washer

Washing equipment for handling parts that must be rotated while they are passing through the cleaning chamber is announced by the *Metal Washing Machine Div., American Foundry Equipment Co.*, 555 Byrkit St., Mishawaka, Ind. Called the "Monorail Spray" washer, it provides a monorail conveyor to carry the work through the path of well-positioned power sprays. Parts are suspended from hooks and can be rotated while passing through the cleaning stages.

Working parts are highly accessible. High pressure pumps and controls are easily serviced. Large doors enable the removal of the spray system for periodic cleaning.

It is constructed so that additional units, like drying and rustproofing sections, may be added easily. The unit can be equipped for heating with steam, gas coils or electric immersion heaters.

Surface Hardening at Machine Gun Speed!

with

-MEGATHERM-*

INDUCTION HEATING

Here is a history-making application of a Megatherm Induction Heating Unit.

On this typical production line setup, 75 bearing pins a minute are surface hardened.

This hardening is done after finish grinding has been completed.

In one high-speed operation the pins are hardened to Rockwell C 60—above file hardness—and costly finish grinding of hardened steel is avoided because scale and distortion are eliminated.

The pins are 2½" long and ½" in diameter, made of chromium molybdenum steel. To heat treat 4,500 bearing pins an hour costs approximately 50¢.

Each pin is heated above critical temperature in less than one second. Quick heating and quenching prevents scaling or distortion and gives accurate control over the hardened case depth.

This is only one of the many new applications of Megatherm Heat in the metal industry. Pieces as small as ⅛" diameter or bearing surfaces up to 6" are handled as easily, all with Megatherm.

More information on how Federal's Megatherm High Frequency Heat can save you money on your production line is yours for the asking. Check Megatherm now.

This Microphoto *magnified 100 diameters shows the hardened surface developed on bearing pins. The white portion is that of the hardened outside layer which extends to a depth of 25 thousandths of an inch. At no point in the zone between the fully hardened case and the unhardened core was there any softening or tempering.*

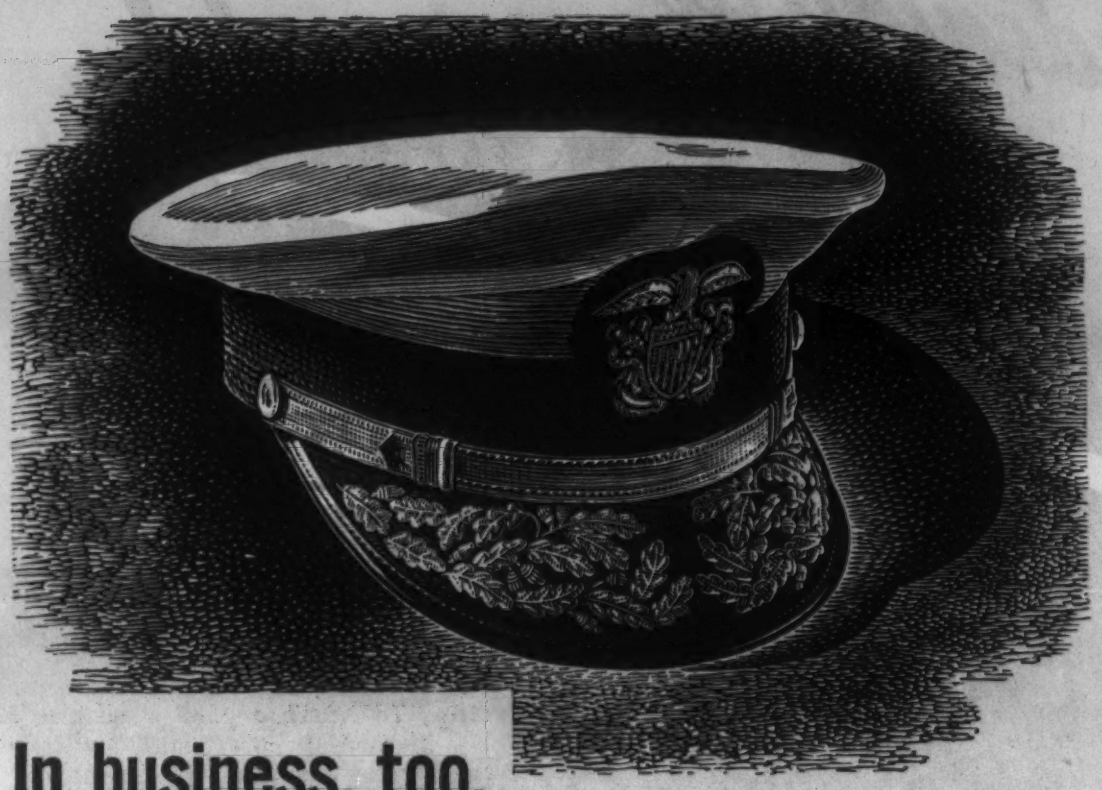
Federal Telephone and Radio Corporation

INDUSTRIAL ELECTRONICS DIVISION

AN IT&T ASSOCIATE

Newark 1, N. J.

*REG. U. S. PAT. OFFICE



In business, too,

TRAINED men reach the top!

Like commissioned officers in our armed forces, business men and industrialists who "reach the top" have a working knowledge of *fundamentals.*

They know how the basic principles underlying business and industry operate; they understand marketing, accounting, finance AND production.

It is this broad knowledge which enables them to hold executive positions—to supervise the activities of specialists, technicians and others.

The Institute's Modern Business Course and Service is designed for men who recognize the obvious necessity of understanding all FOUR important departments of business and industry. It is practical, intensive and scientific!

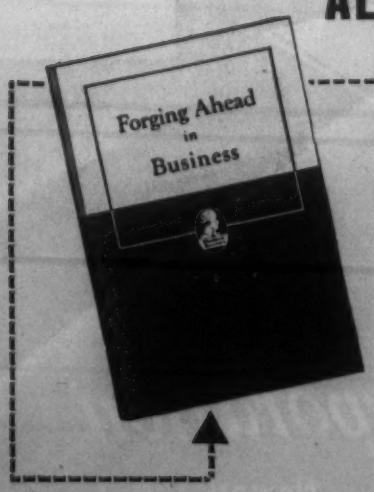
With the help of Institute training, ambitious men can strengthen their present positions while preparing for bigger, better jobs tomorrow.

Among the prominent men who have contributed to the Course are: Thomas J. Watson, President, International Business Machines Corp.; Frederick W. Pickard, Vice President and Director, E. I. du Pont de Nemours & Co.; Clifton Slusser, Vice President, Goodyear Tire & Rubber Co.

Send For "Forging Ahead in Business"

The Institute's story is factually told in the fast-reading pages of its famous little book, "Forging Ahead in Business." There is no charge for this booklet; no obligation involved. To men who are genuinely interested in self-improvement, "Forging Ahead in Business" has a message of distinct importance. Simply fill in and return the coupon below, and your FREE copy will be mailed to you promptly.

ALEXANDER HAMILTON INSTITUTE



Alexander Hamilton Institute
Dept. 163, 71 West 23rd St., New York 10, N. Y.
In Canada: 54 Wellington Street, West, Toronto 1, Ont.

Please mail me, without cost, a copy of the 64-page book—"FORGING AHEAD IN BUSINESS."

Name.....

Firm Name.....

Business Address.....

Position.....

Home Address.....

Improvements in "Zero" Welding Equipment

Improvements in the complete line of "Frostrode" industrial refrigeration units, extensively used for "Zero-Welding" and other purposes, are heralded by *Frostrode Products,* 19003 John R, Detroit 3. Among them are a new improved evaporator coil arrangement that eliminates all sharp bends, minimizes the back pressure of the refrigerant, and permits unrestricted flow of the coolant.

There are no low "pockets" to accumulate sediment and plug-up. Improved refrigerant expansion valves have increased the sensitivity of this unit to temperature variations, insuring closer control of coolant temperature through faster response.

Greater ease of inspection and maintenance result through re-location of the thermometer bulb and expansion valve near the removable inspection panel.

The line now comprises four basic standard units—Models 751, 1501-E, 3002 and 5001—designed to maintain 0 F. to 10 F. coolant temperature during the continuous production runs of one, two, four and six light aluminum welders, respectively, or the equivalent load of steel welders or other machines.

One or more coolant circulating pumps are built into the units as required for any specific operation. In addition, special units are available for use with low temperature cabinets, test chambers, processing baths, etc.

All units are now designed for the use of methyl chloride refrigerant in line with Governmental requests to conserve the supply of Freon for critical service uses.

● For engraving on steel stamps, die and parts placed under torsion, tension, bending, etc., "Lo-Stress" steel stamps have been devised by *Jas. H. Matthews & Co.,* 3942 Forbes St., Pittsburgh 13. A feature is the rounded face and special character design providing minimum set-up stress. The tools have a controlled depth feature, successful for thin sheet aluminum, steel, etc. where 0.003 to 0.006 in. depth of stamping must be maintained.

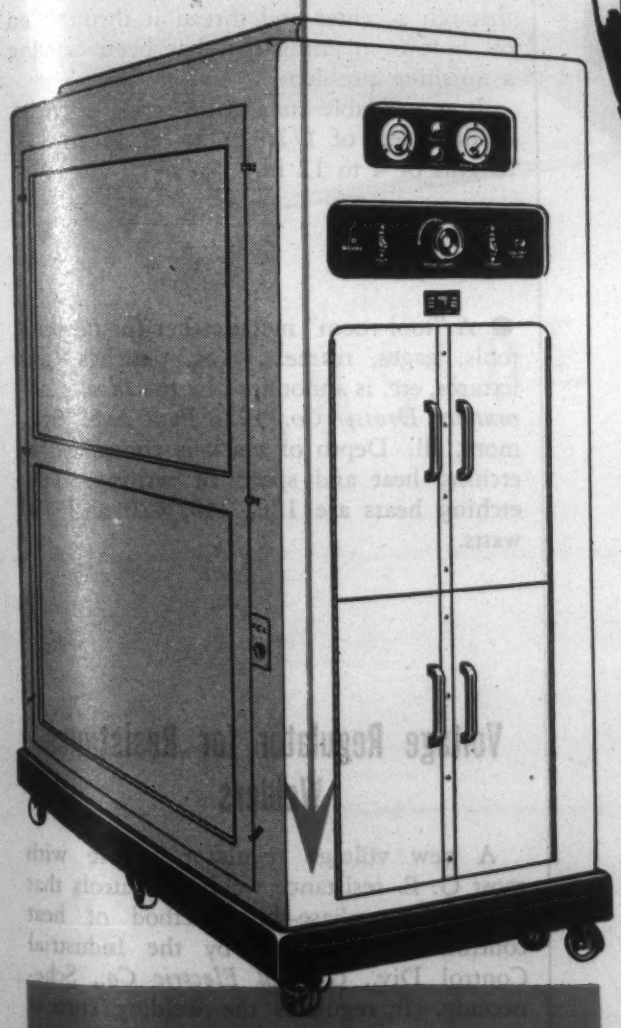
General Purpose Electrode

A new general purpose electrode for mild steel, "Fleetweld 35," specifically for operation on a.c., is announced by *Lincoln Electric Co.,* Cleveland. This new shielded arc electrode, which will also operate on d.c. with either polarity, is suitable for high-speed welding of single or multiple passes in flat, vertical or overhead positions.

It is available in 1/8 in., 5/32 in. and 3/16 in. sizes. As-welded weld metal specimens test: Tensile strength, 62,000 to 70,000 p.s.i.; yield strength, 52,000 to 57,000 p.s.i.; elongation, 23 to 30%.

It is made in standard 14-in. lengths, and is packed in 50-lb. containers.

There's no ONE-MAN-BAND in Electronic Heating



Our equipment offers you a selection of frequencies up to 300 megacycles — and the following power range, with stepless control from zero to full load:

3 Kw
5 Kw
7½ Kw
10 Kw
12½ Kw
15 Kw
18 Kw
25 Kw
40 Kw
100 Kw

Although it is possible to construct an electronic heater that will generate a great range of high frequency currents, it will not perform *all* heating jobs efficiently and it would be very costly in use.

Virtually every application of electronic heating requires a specific FREQUENCY AND POWER combination. Therefore, to realize the maximum advantages of this improved heating method, *each installation should be designed and built for its particular application.* For example: when a heating operation can best be done at 5 kw and 22 megacycles it would be *wasteful* and *inefficient* to use a machine that delivers 20 kw at 500 kc.

Many first-time users of electronic heating are induced to buy "misfits" when they try to find an all-purpose machine. Our extensive line of equipment offers you the broadest range of power and frequency combinations at *prices lower* than other makes of comparable quality.

Investigate the production economies and advanced engineering designs offered by our greater variety of units . . . each one time-tested for high efficiency.

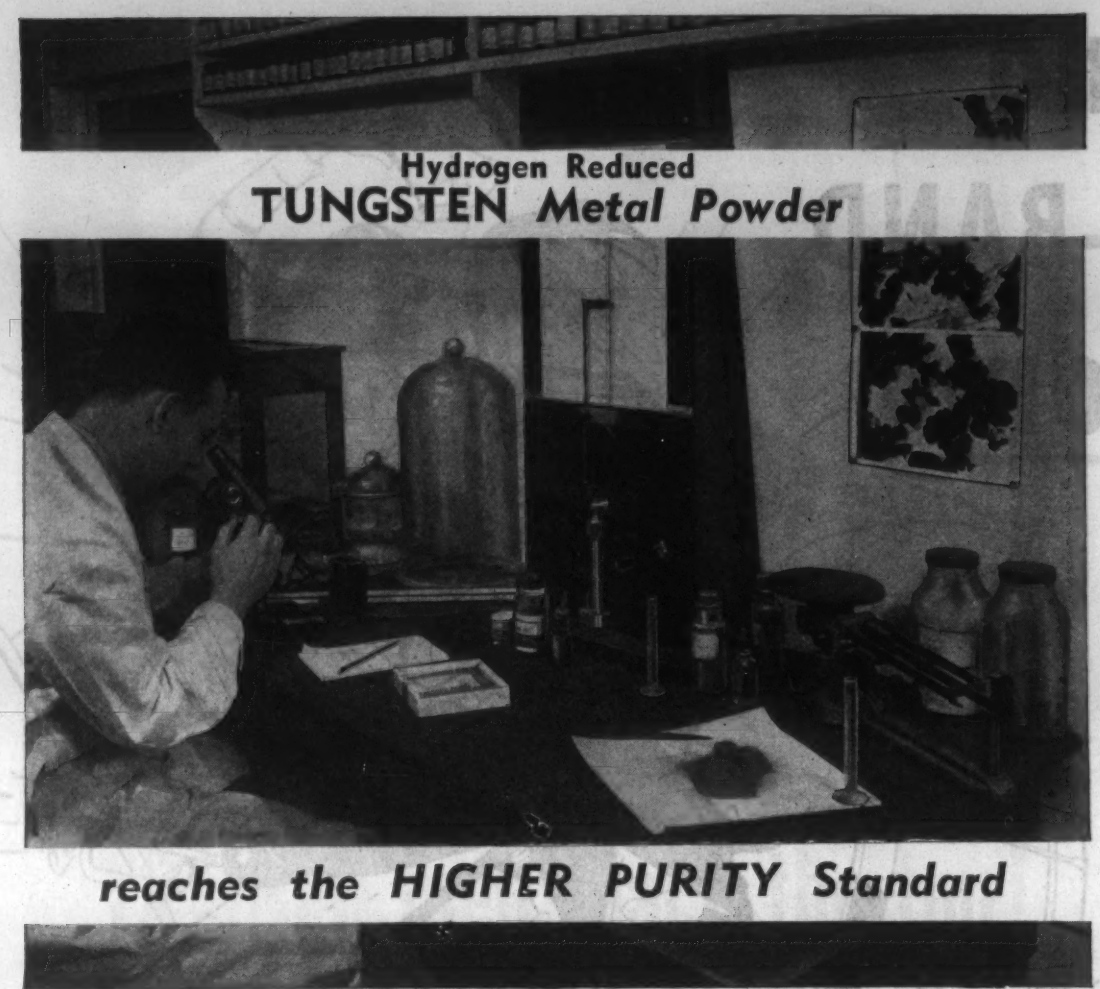
Before you buy write to us for detailed information

Scientific Electric

DIVISION OF "S" CORRUGATED QUENCHED GAP COMPANY

119 Monroe Street Garfield, New Jersey

Manufacturers of Vacuum Tube and Spark Gap Converters since 1921



Hydrogen Reduced
TUNGSTEN *Metal Powder*

reaches the HIGHER PURITY Standard

Higher purity and strict micron size control are important factors in Tungsten Metallurgy as used in the manufacture of tungsten carbide and electronics.

At the laboratory of the Reduction and Refining Company this ceaseless effort to produce Tungsten Metal Powder to meet the exacting demands of industry has been uniformily successful. We are now producing for the manufacturer in the carbide field our unsurpassed—

XXX A Hydrogen Reduced
TUNGSTEN METAL POWDER
Purity 99.9+ per cent
Approx. Particle Size 90% below 1 micron

This specially developed product has proved a highly superior material for the cutting tool industry, and greatly reduced the average losses sustained through rejects.

Compounds of Tungsten for the Ceramic Industry and Manufacturers of Pigments

Tungstic Acid and Tungsten Oxide, having a purity of 99.9+ per cent are now in available production at our plant. These compounds of incomparable quality are fully meeting the demands of the industries.
Inquiries invited. Samples will be sent on request.

Literature on the development and uses of TUNGSTEN METAL POWDER produced at the Reduction & Refining Company plant is available upon request.

R&R TUNGSTEN QUALITY POWDERS
REDUCTION and REFINING COMPANY
96 Roanoke Avenue, NEWARK, N. J.
Continental Ore Co., 300 Fifth Ave., New York, Selling Agents

Abrasive Strip for Oil Hole Finishing

For finishing oil holes in hard-to-get-at areas, a new type of spiral wound abrasive strip is announced by the *Minnesota Mining & Mfg. Co.*, St. Paul. It is called

"Elek-Tro-Cut Three-M-ite Cloth Reinforced Spiral Wound Strip."

The center is reinforced so that it can be bent over. One can then reach down through a center and thread it through an oil hole or opening that has been causing a finishing problem.

It is available in a wide range of grits, in diameters of 1/16 in. to ¼ in. and in lengths of 4 to 12 in.

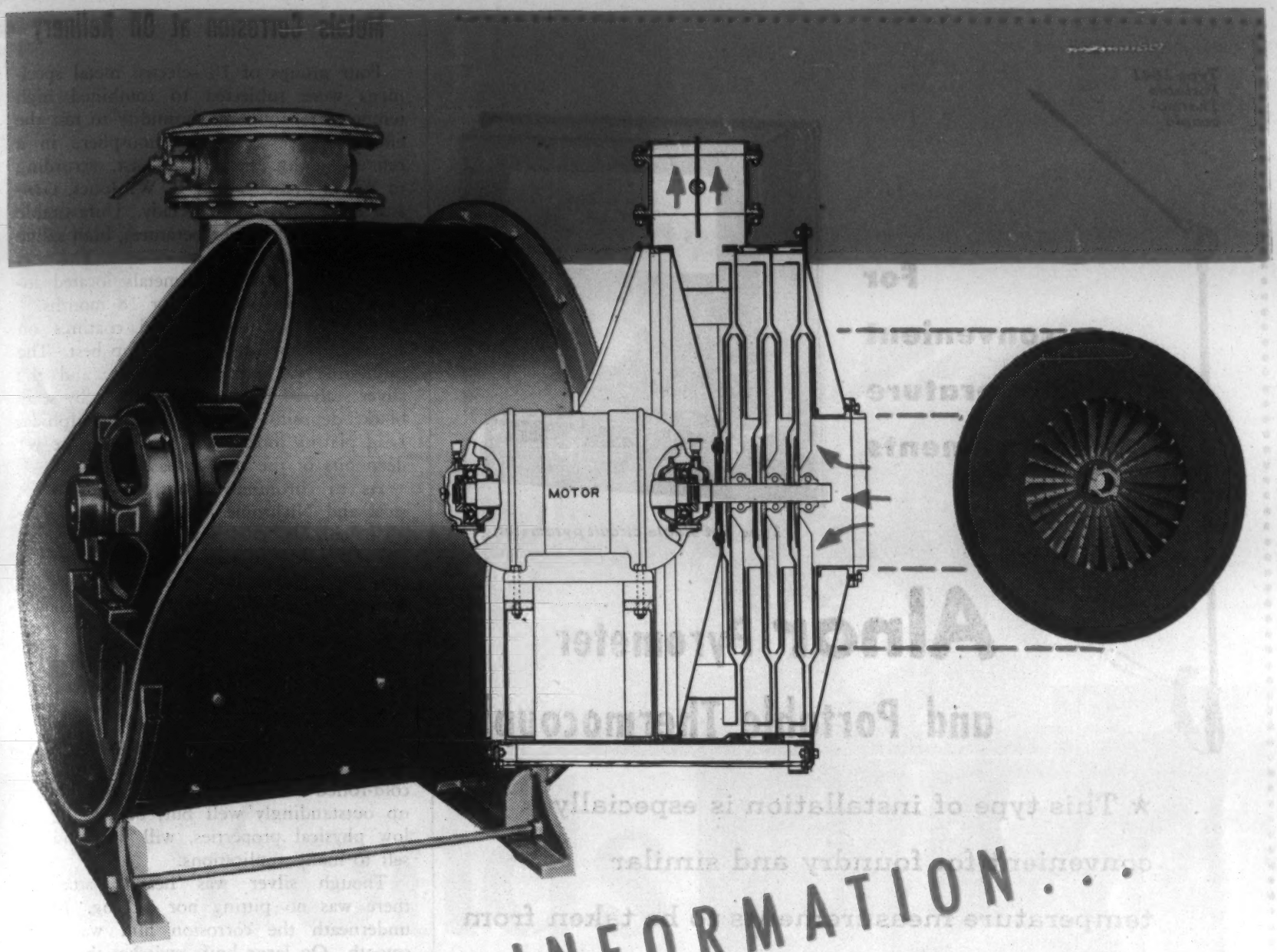
● A "tool room" metal etcher for marking tools, gages, reamers, dies, punches, jigs, fixtures, etc. is announced by the *Ideal Commutator Dresser Co.*, 1928 Park Ave., Sycamore, Ill. Depth of mark is controlled by etching heat and speed of writing. Four etching heats are 120, 240, 420 and 700 watts.

Voltage Regulator for Resistance Welders

A new voltage regulator, usable with most G. E. resistance welding controls that include the phase-shift method of heat control, is announced by the Industrial Control Div., *General Electric Co.*, Schenectady. It regulates the welding current automatically, holding it constant regardless of line-voltage variations of as much as plus 10 or minus 20%.

Known as the CR7503-D157, the regulator consists of a resistor circuit connected to the power line that supplies the welding machine, and an electronic circuit. It can be used on welding circuits whose power factor is from 20 to 70%, and can be operated from 230-460-575 volts on a 50-60 cycle power supply.

It can compensate for a sudden voltage drop in less than 3 cycles, with about 75% of the compensation taking place during the first cycle.



INSIDE INFORMATION . . .

Spencer Turbos are shipped "ready to use," require no special foundations, and work quietly and reliably for years without "tear downs," overhauls or repairs. Therefore few people know what "makes them tick" or realize that their very simplicity is responsible for the outstanding performance records.

The cross-section view above shows a series of light weight impellers clamped to a large shaft which rotates on the two motor bearings.

Air Pressure is constant regardless of load. Power used varies with the volume of air delivered. A one-piece casing, and a bridge-type motor support, plus perfectly balanced impellers with wide clearances, account in part for the long-life service rendered and the extremely low costs for maintenance and repair.

If interested, the Spencer Turbo Data Book and the Spencer Bulletins will give you all the information.

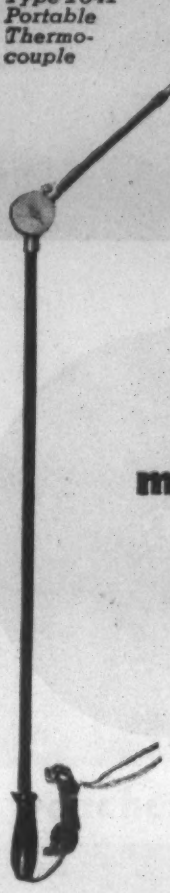
SPENCER
HARTFORD

THE SPENCER TURBINE COMPANY • HARTFORD 6, CONNECTICUT

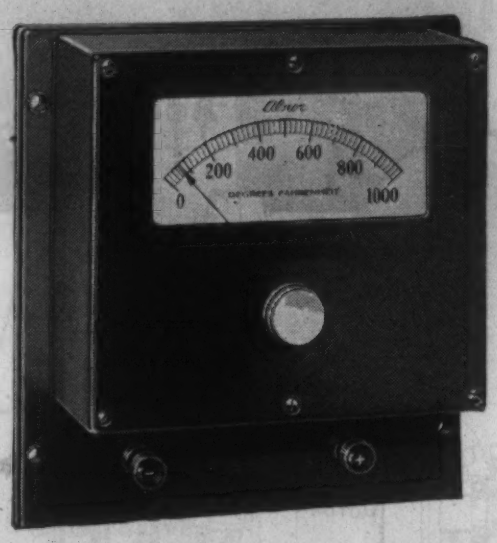
257-B

TURBO-COMPRESSORS

Type 1641 Portable Thermo-couple



For convenient temperature measurements



Type RM single circuit pyrometer

Alnor Pyrometer and Portable Thermocouple

★ This type of installation is especially convenient for foundry and similar temperature measurements to be taken from the same group of melting pots and crucibles at frequent intervals. The Alnor pyrometer may be mounted on wall, bracket, or post, and is protected against accident hazards. The portable thermocouple is an enclosed, protected lance type, easily handled, and furnished with a portable cord to connect to the wall mounted indicating instrument.

Type RM single circuit or two-point pyrometer is built in several standard ranges, 0-400 deg. F. to 0-2500 deg. F. Write for descriptive Bulletin 2929.

ILLINOIS TESTING LABORATORIES, INC.
420 NORTH LA SALLE STREET
CHICAGO 10, ILLINOIS

Metals Corrosion at Oil Refinery

Four groups of 18 selected metal specimens were subjected to combined high temperature and high humidity to test the effects of the corrosive atmosphere in a refinery along the Gulf Coast, according to W. L. Maucher and B. W. Jones, *General Electric Co.*, Schenectady. Unfavorable conditions of high temperatures, high saline humidity and plant gases existed. The tests covered two groups of metals located indoors and two outdoors for 18 months.

Of the four electroplated coatings on copper, tin appeared to stand up best. The cadmium was completely gone, and the silver suffered heavy attack, shown by scaly black deposit, probably silver sulphide. Lead plating looked fair on the surface yet deep pits of the copper base appeared.

As to chromium alloys, 18-8 stainless steel and Nichrome V tied for best. The 25% chrome steel was somewhat worse; the 12% chrome steel decidedly worse. Untreated aluminum showed up nearly as well as the 18-8 stainless. It was decided that aluminum, anodized and given two or more coats of aluminum paint, would prove effective.

High copper metals were shown to have a low resistance to corrosion and certainly need protective coating. Nickel was not attacked as much as Monel. Unprotected cold-rolled steel did poorly. Lead showed up outstandingly well but, because of its low physical properties, will not lend itself to many applications.

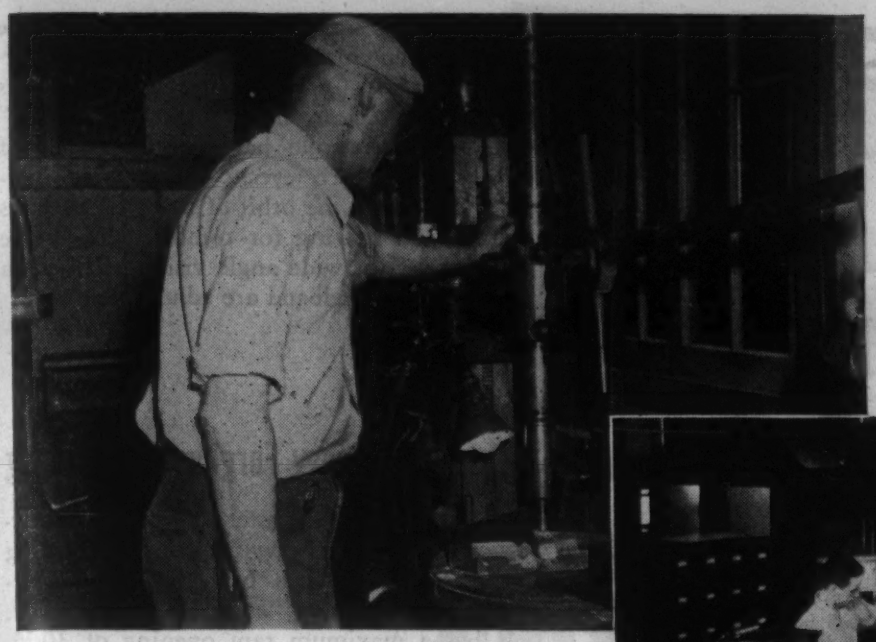
Though silver was heavily attacked, there was no pitting nor etching. Metal underneath the corrosion film was very smooth. On large knife switches the silver surfaces continued to carry their currents satisfactorily.

Metallizing Gun

A new metallizing gun for high-speed production spraying of low melting point metals is announced by *Metallizing Engineering Co., Inc.*, 38-14 30th St., Long Island City 1, N. Y. Called the Metco type 3E, it uses ⅛-in. zinc, tin, lead, solder, babbitt, cadmium or fine gage copper and its alloys. Rates of deposition, in pounds per hr., are: Zinc, 40; tin, 70; lead, 110; solder, 90 and babbitt, 75.

The patented controlled power unit provides automatic spraying speed hour after hour. Air pressure fluctuations do not affect operating efficiency. A universal gas head allows for operation on any commercial gas in conjunction with oxygen and compressed air.

Owners of Type E or 2E guns may have their present equipment quickly converted to Type 3E. Typical applications are: Corrosion-resistant coatings on iron and steel structures and equipment; water- and chemical-resistant linings for storage tanks and degreasers; conductive and soldering surfaces on glass plastics and carbon products.



45 seconds from MELT SHOP TO LABORATORY

At regular intervals during the melting of a heat of Timken steel, small casts of the molten metal are taken for chemical analysis. Drillings from these test pieces are whisked through pneumatic tubes to the clean, quiet, modern Timken chemical laboratory which is located one-quarter of a mile away from the melt shop, free from the thundering noise and vibrations which might upset delicate instruments. Here a rapid, accurate chemical analysis is made and the results are flashed back via the telautograph to the melter who uses them to control the quality and uniformity of Timken alloy steel.

This close metallurgical control plus over 25 years of know-how enables Timken to produce heat after heat of electric furnace and open hearth steels of accurate chemical analysis and correct physical properties. A combination that has been used time and again to lick tough jobs.

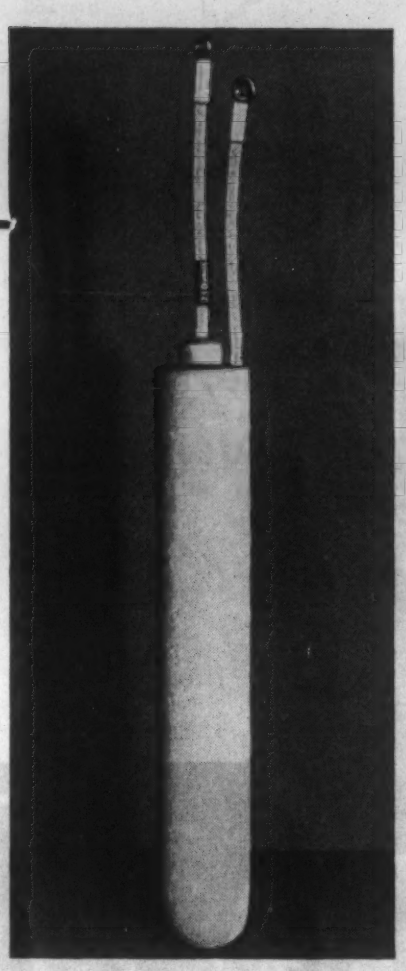
Today Timken Alloy Steels are being used for the vital parts of Uncle Sam's great fighting machine. Tomorrow they will be ready to serve you again in a wide range of analyses to meet your individual needs. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

ALLOY STEELS

For Heating Acid Solutions



VITREOSIL
IMMERSION HEATERS
offer
3 Outstanding Advantages!

Electric immersion heaters are admirable for heating acid solutions, but the envelope for the heating unit must be acid-resistant, a good electrical insulator, and unaffected by thermal shock. Vitreosil (vitreous silica) possesses all these properties.

1 Chemical Inertness With the exception of fluorine and hydrofluoric and phosphoric acids, Vitreosil is unaffected by halogens and acids regardless of temperature or concentration.

2 Electrical Insulating Qualities Vitreosil surpasses porcelain, mica, glass and similar materials in that it maintains its insulating value despite extreme temperature conditions.

3 Low Expansion Vitreosil may be exposed to rapid and extreme thermal shock without danger of breakage because its expansion is the least of any commercial ceramic.

VITREOSIL CONTAINERS FOR HEATING ACIDS

Round Bottom Evaporating Dishes
Cylindrical Pots
Rectangular Tanks
Four-sided Trays
Retorts or Dissolving Jars

Vitreosil Electric Immersion Heaters are available in lengths ranging from 10 to 30 inches with k.w. ratings of .25 to 5.0. Write us for explicit data and quotations.

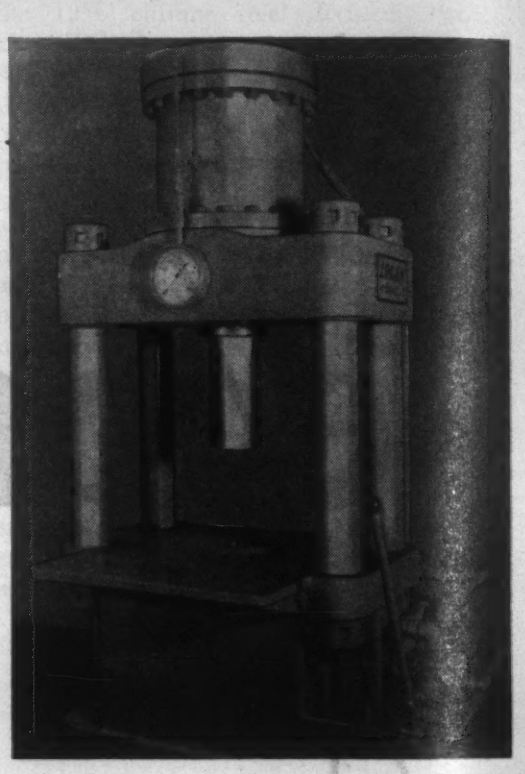
VITREOUS SILICA — VITREOSIL — REG'D TRADE MARK

THE THERMAL SYNDICATE, LTD.
12 EAST 46th STREET, NEW YORK 17, N.Y.

● A new small-size eyecup safety goggle for women chippers is announced by *American Optical* Co., Southbridge, Mass. It is fitted with clear, flat "Super Armorplate" lenses, the goggle having an eye size of 44.6 mm. Each eyecup is designed individually to fit the orbit of the eye. Surfaces are broad bearing for comfort, the goggle is low set for wide angle vision. Ball-chain bridge and headband are adjustable.

Press for Heavy Forging and Forming

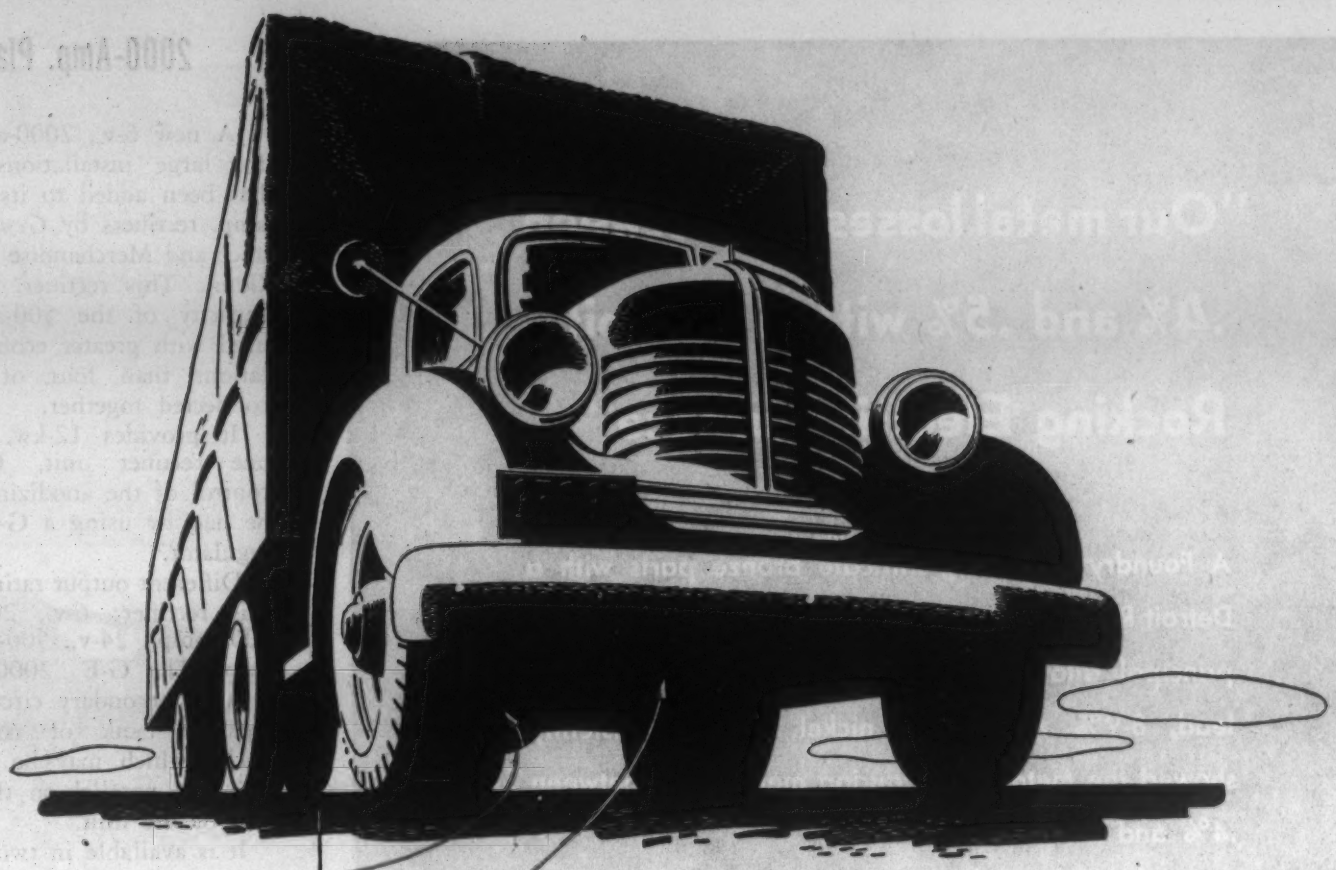
A special four-poster tie rod type hydraulic press for heavy forging and forming operations has been built by the *Logansport Machine Co., Inc.,* Logansport, Ind. It has a maximum ram opening of 30-in. and a 15-in. stroke.

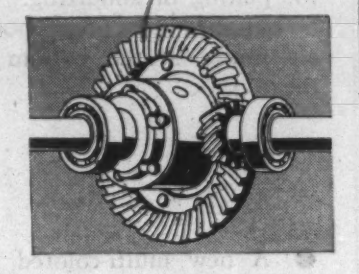


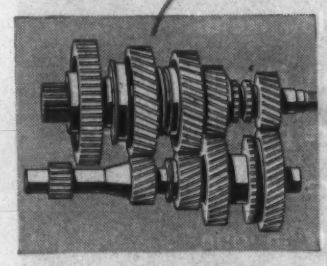
A dual volume hydraulic pump provides low pressure operation during the non-forcing portion of the operating cycle and high pressure application during the actual forcing portion of the cycle. The change-over is done automatically as demanded by the resistance to the ram.

The proportional pressure valve permits the gradual application of pressing force in any degree from zero to full capacity. A special platen extension facilitates loading and unloading.

● One of the largest pieces of stainless steel tubing made in production quantities is that turned out by *Babcock & Wilcox Tube Co.,* Beaver Falls, Pa., used as antennae masts on submarines. These 40-ft. tubes have to withstand the same hydrostatic pressure as the body of the sub; the metal must be non-magnetic; it must be extremely corrosion resistant; the tubes must be absolutely straight as the masts are projected up and down through the stuffing box; the tubes must be machined to exceptionally close tolerance, or 0.002 in. The surface must not have a single blemish.







Follansbee pre-forging for sound alloy steels

Wherever severe conditions put steels to the test—whether it be in transmission gears in heavy trucks and bulldozers, or in the landing struts of giant aircraft—Follansbee Pre-Forging demonstrates its value.

Follansbee, though it furnishes only the basic steel—from blooms to strip—brings the advantages of forging into the very first operation after the ingot is poured. Pre-Forging is the exclusive process which presses ingots into blooms and billets . . . imparts a uniform density and grain structure that can be relied upon, shipment after shipment.

For forgings—or for products requiring sheets and strip—Follansbee Pre-Forging and the skill of its compact organization assure the sound alloy steels that respond properly to your heat treating and working quality requirements.

FOLLANSBEE STEEL CORPORATION

GENERAL OFFICES • PITTSBURGH 30, PA.

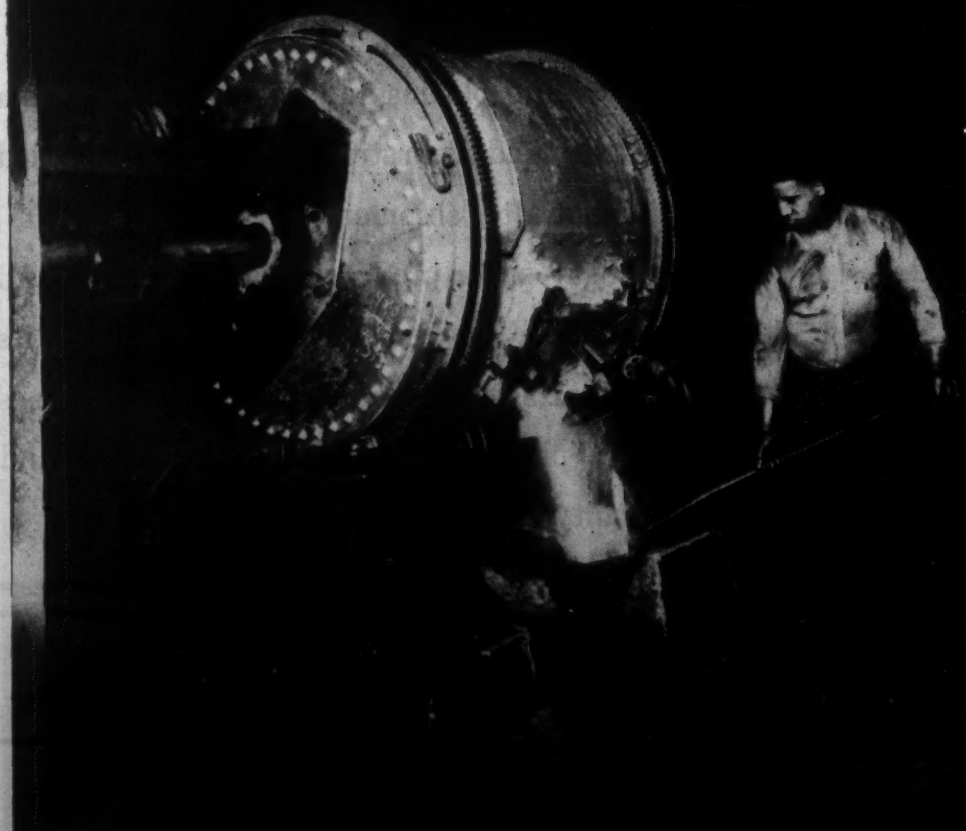
Sales Offices—New York, Philadelphia, Rochester, Cleveland, Detroit, Milwaukee. *Sales Agents*—Chicago, Indianapolis, St. Louis, Nashville, Los Angeles, San Francisco, Seattle; Toronto and Montreal, Canada. *Plants*—Follansbee, W. Va. and Toronto, O.

ALLOY BLOOMS, BILLETS, BARS, SHEETS & STRIP • COLD ROLLED SHEETS & STRIP
POLISHED BLUE SHEETS • ELECTRICAL SHEETS & STRIP • SEAMLESS TERNE ROLL ROOFING

"Our metal losses run between .4% and .5% with a Detroit Rocking Electric Furnace"

A Foundry producing intricate bronze parts with a Detroit Rocking Electric Furnace Wrote recently, "Our principal alloy is 78-79% copper 2½% tin, 10% lead, 8-9% zinc, 0.5% nickel. Tests consistently showed the metal losses during melting run between .4% and .5%."

Records in scores of foundries show similar low metal losses and many other advantages. Detroit Electric Furnaces require less labor and produce more pounds of perfect castings per man-hour. They produce as many as 8 ferrous or 16 non-ferrous heats in one eight-hour day. Because they allow precise metallurgical control of any formula, Detroit Furnaces assure superior metallurgical results. Built in capacities from 10 to 8,000 lbs. Write today for further facts.



DETROIT ELECTRIC FURNACE DIVISION
KUHLMAN ELECTRIC COMPANY • BAY CITY, MICHIGAN

2000-Amp. Plating Rectifier

A new 6-v., 2000-amp. plating rectifier for large installations, the G-E "2000," has been added to its 300-amp. and 500-amp. rectifiers by *General Electric's* Appliance and Merchandise Dept. in Bridgeport, Conn. This rectifier, with four times the capacity of the 500-amp. outfit, can be used with greater economy in large installations than four of the smaller units connected together.

It provides 12-kw. output capacity in one rectifier unit. Complete automatic control of the anodizing power supply can be had by using a G-E automatic voltage regulator.

Different output ratings are possible with this rectifier: 6-v., 2000-amp. or 12-v., 1000-amp.; 24-v., 500-amp. or 48-v., 250-amp. The G-E "2000" rectifier has two separate secondary circuits, each feeding a separate bank of copper-oxide rectifier stacks, which may be connected either in series or parallel on the d-c buses in the rear of the unit.

It is available in two a-c supply ratings: 230-v. and 440-v., three phase, 60 cycles. Two or more rectifiers may be connected in series, parallel to provide practically any output voltage and current required for plating or anodizing. The G-E "2000" is designed for floor mounting with the air intake at the bottom and exhaust at the top.

● A new multi-colored plastic thickness gage that enables the user to ascertain quickly the thickness of a tested piece by color, is announced by *Industrial Products Suppliers*, 2 Broadway, New York 4. Pocketknife size, it has 11 leaves with thickness ranging from 0.0015 to 0.030 in. The company also makes colored plastic shim stock and arbor spacers.

Salvaging Threads in Castings

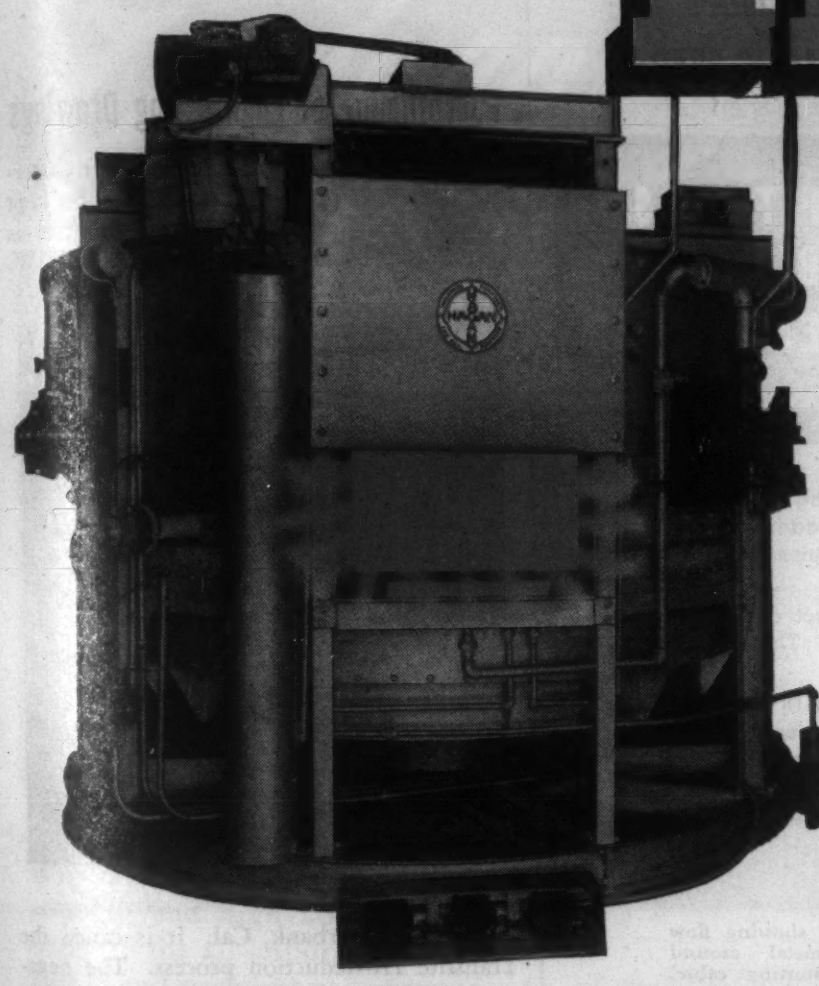
Parts, with damaged or wrong sized threads, such as in castings, can be salvaged by the use of Rosan locking systems for threaded inserts and studs. A steel insert is locked firmly in place, but may be removed easily and replaced without disturbing the parent material.

The Rosan inserts are made in two pieces, a body and a locking ring, and are manufactured by *Bardwell & McAlister, Inc.*, Hollywood 28. The locking ring, which is serrated inside and out, engages its inner teeth with the serrations of a collar on the insert or the stud, while its outer teeth broach the wall of a counterbore around this collar when the ring is pressed or driven into place.

The installation is completely permanent, but the fastening unit may be removed easily by a simple, shallow drilling operation. For cast iron installations, the ring is case hardened. The general rule is that it may be installed in any material that is softer than the steel locking ring.

The men responsible for America's Outstanding Record of FORGING PRODUCTION SPECIFY

HAGAN



ROTARY FORGING FURNACES

Since they include the most advanced design proven by the largest number of operating installations.

Nearly 200 Hagan Rotary Hearth Forging Furnaces are setting new production and cost records for many of America's leading war material manufacturers. Accurate control of heating time and temperature insure a continuous flow of uniformly heated billets varying from 1" x 1" to 10" x 10" sections. Less heating time is required, fuel consumption is reduced in some instances as much as 58%, labor costs are lower, lost furnace time is negligible. These units are available in nine sizes from 4' to 26' hearth diameters with heating capacities from 600 to 20,000 lbs. per hour.

In addition to Rotary Forging Furnaces, Hagan also designs and builds dependable furnace equipment for annealing, carburizing, hardening, drawing, forging and many other specific operations.

Descriptive Bulletin will be sent on request.

GEORGE J. HAGAN COMPANY
PITTSBURGH, PENNA.
Detroit · Los Angeles · Chicago · San Francisco

NEW "Standard" CABLE SWAGER

with **AUTOMATIC DIE OPENER** *and* **AUTOMATIC FEED**

"Standard" Cable Swaging Machine showing cable guide, die opening lever, foot pedal for feed control and hand adjustment for change of fitting sizes.

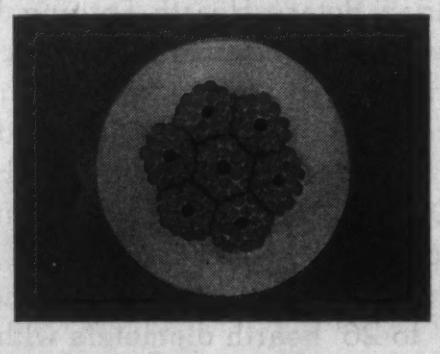
ATTACHES FITTINGS TO CABLE 10 TO 15 TIMES FASTER

THAN FORMER MODEL OF "STANDARD" CABLE SWAGER

"Standard's" redesigned Cable Swager provides the same swaging action as used so successfully in regular "Standard" Cable Swagers and, in addition, with its automatic equipment, eliminates the extra operator formerly required, as well as the need for removing dies after each cable swaging operation.

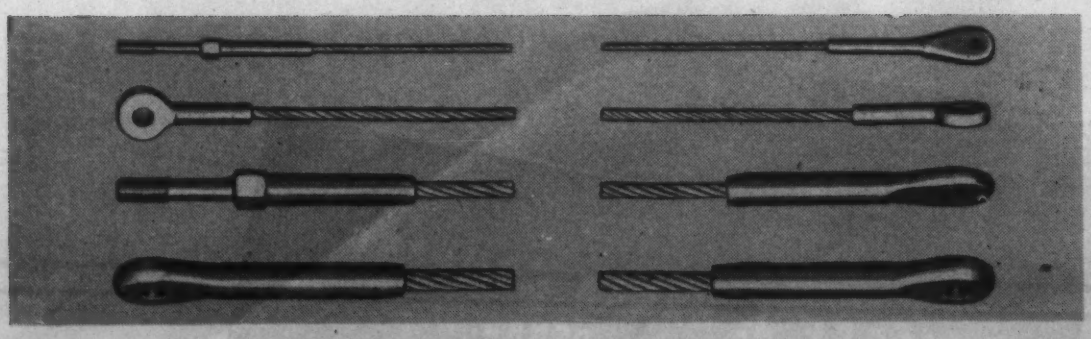
Fittings have a smooth surface and are swaged so firmly to exact dimensions on the cable, that fitting and cable strands appear to be fused. This connection exceeds the tensile limitations of the cable itself.

Four sizes of "STANDARD" Cable Swaging Machines are offered to handle cable sizes from 1/16" to 1½". Fitting designs are not a factor as machines are provided with hand adjustment to handle specific types and sizes and to bring attachments to the required dimensions. In operation this new machine is safe, simple and amazingly productive. Only three seconds are required for each complete operation.



Cross section showing flow of shank metal around strands without distorting cable.

Examples of shank-type fittings as swaged on cable.



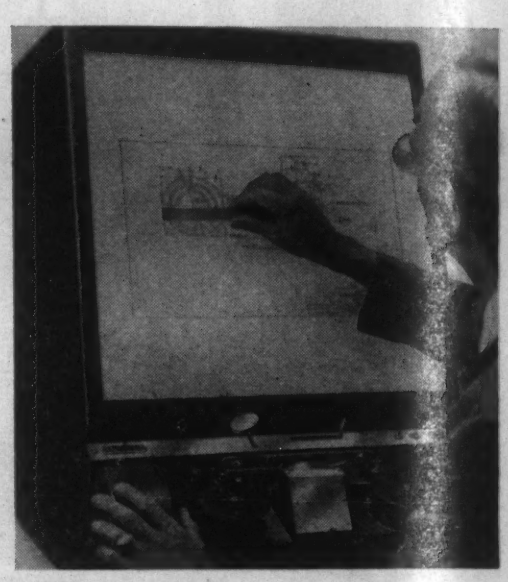
Write for folder on Cable Swagers.

STANDARD MACHINERY CO.
PROVIDENCE 7, RHODE ISLAND

● A new material that will cement various metals to each other, or in various combinations, is called "Durite" Special Heat-Setting Cement S-3024, and is made by *Durite Plastics, Inc.*, Frankford Station P. O., Philadelphia 24. It will adhere satisfactorily to many other substances, such as phenol resins. Tensile peak values as high as 7500 p.s.i. have been obtained. Electric iron handles may be kept cool by molding the parts in halves and cementing with Durite to provide a strong unitary product, including an irregularly-shaped cooling channel.

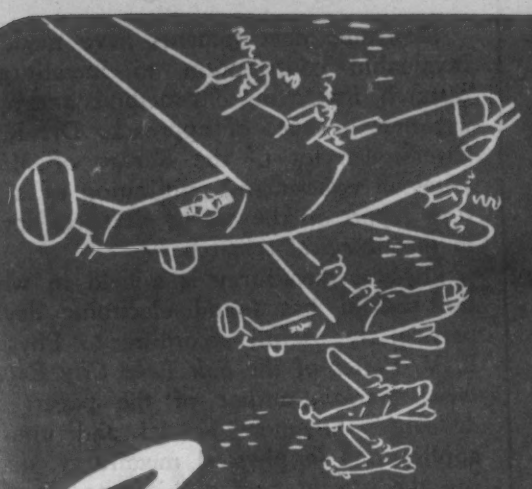
Microfilming of Engineering Drawings

Equipment for microfilming of engineering drawings or other material to be kept in industrial manufacturing plant files is announced by *Microcopy Corp.*, 2800 W. Olive Ave., Burbank, Cal. It is called the Translite Hi-Reduction process. The negative can be used to make copies on other pieces of film or to enlarge.



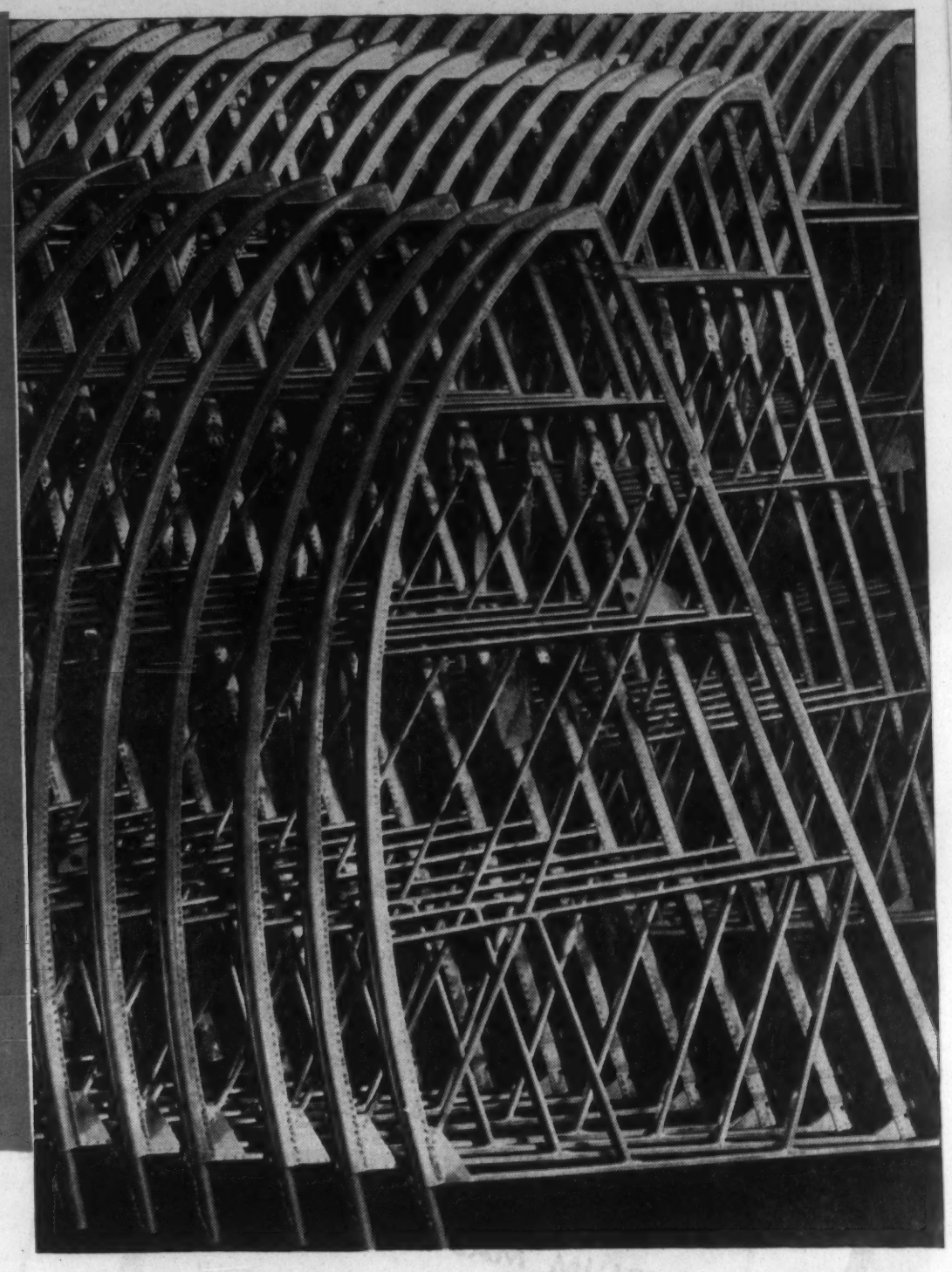
The photographs are on a continuous roll, and they save 90 to 98% filing space. Duplicates may be reproduced quickly on film, paper, tracing paper or cloth. For reading Microcopy, a multiple-magnification viewer is supplied, which is operated on a motion picture film projector principle.

● Switch plates and panels for the automotive and aviation industries are now produced from extruded Tenite sheet. Depressed lettering molded into the sheets is filled with a synthetic resin base material of a suitable color, and the plates are fabricated by shearing or die cutting. The material is flexible and resistant to weather, petroleum products and de-icing fluids. It has dimensional stability. The panels are molded by *Willson Magazine Camera Co.*, Philadelphia, from Tenite extruded by *Plax Corp.*, Hartford, Conn. The Tenite is a cellulose acetate butyrate product of Tennessee Eastman Corp., Kingsport, Tenn.



Enduro

LIGHTENS STRUCTURAL ASSEMBLIES WITHOUT SACRIFICE OF STRENGTH OR SAFETY



Wherever light weight, high physical strength and high corrosion-resistance are the all-important factors in design and performance of structural members, the answer probably is Republic ENDURO Stainless Steel.

In 18-8-HT analysis, this high strength-to-weight-ratio metal can be produced with a tensile strength in excess of 185,000 p.s.i., and with good yield point and ductility.

Republic ENDURO is highly resistant to rust and corrosion—hence does not require extra thickness to insure against weakening due to loss of metal caused by corrosion. And no protective coating is necessary.

Another important feature of ENDURO is its resistance to heat and cold. It possesses high creep strength—also resists embrittlement at sub-zero temperatures.

Because of this combination of qualities, ENDURO Stainless Steel offers unusual possibilities to designers and engineers who would like to employ smaller or lighter sections in structural assemblies—without sacrifice of strength or safety. And its uniform workability and weldability by all modern methods recommend it to production engineers.

Would you like to know more about the structural possibilities of Republic ENDURO—for instance, how its application can improve high-speed, pay load-carrying mobile equipment such as trains, aircraft, trucks, buses and marine craft?

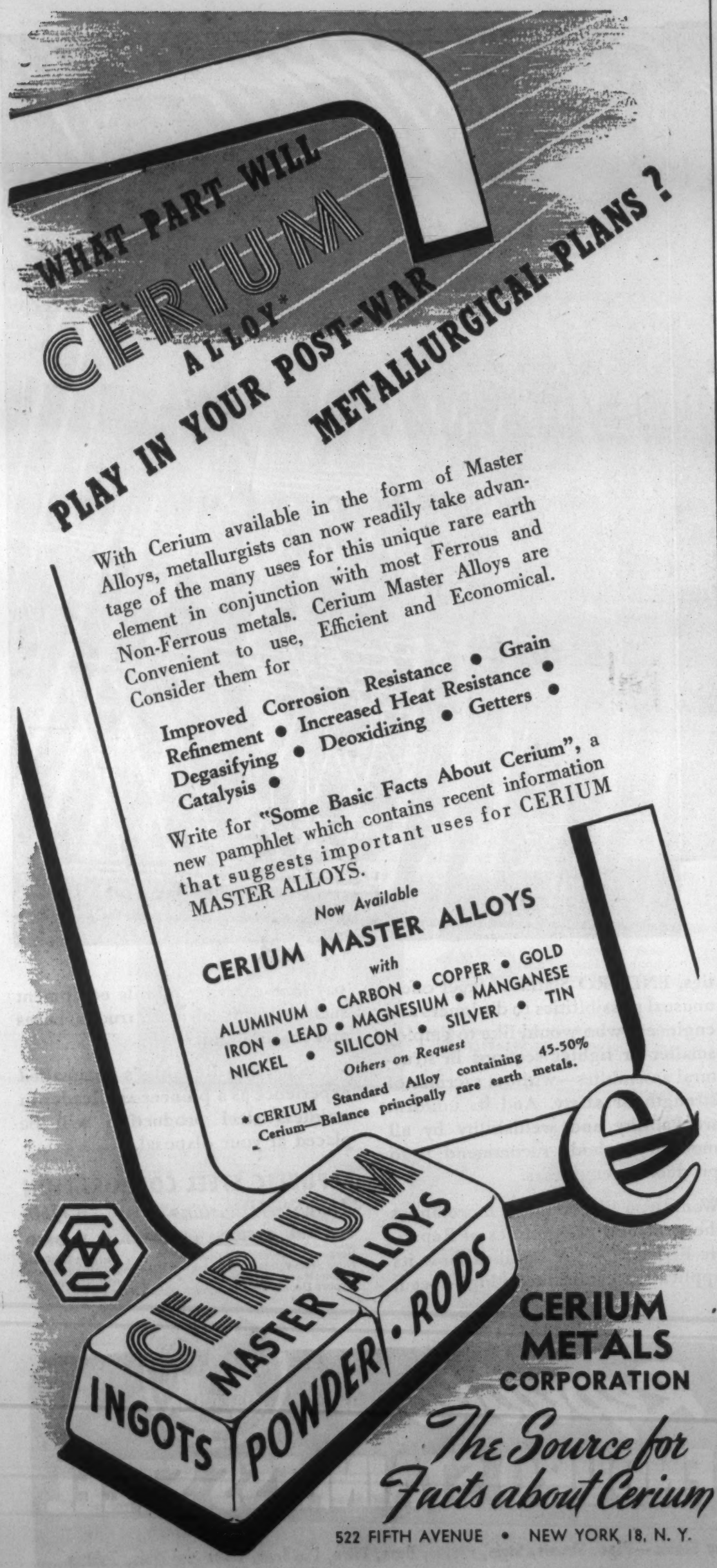
Write us, and Republic's unequalled experience as a pioneer and leader in stainless steel production will be placed at your disposal.

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO

Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Steel and Tubes Division
Union Drawn Steel Division • Truscon Steel Company
Export Department: Chrysler Bldg., New York 17, N. Y.

Republic
ENDURO STAINLESS STEEL
Reg. U. S. Pat. Off.

Other Republic Products include Carbon and Alloy Steels—Pipe, Sheets, Strip, Plates, Bars, Wire, Pig Iron, Bolts and Nuts, Tubing



Electronics in Metallurgical Research

Electronic developments have made an invaluable contribution to metallurgical research, improving old methods and opening new avenues of approach, Dr. R. R. Sayers, director of the *Bureau of Mines,* states in announcing publication of a Bureau report on the use of electrical devices in metallurgical research.

Physical metallurgy is a field in which the Bureau has found electronic devices particularly useful, according to Physicist E. V. Potter of the *Salt Lake City Experiment Station,* author of the paper. He describes the more special and unusual applications in physical metallurgy, devoting the greater part of his report to this phase.

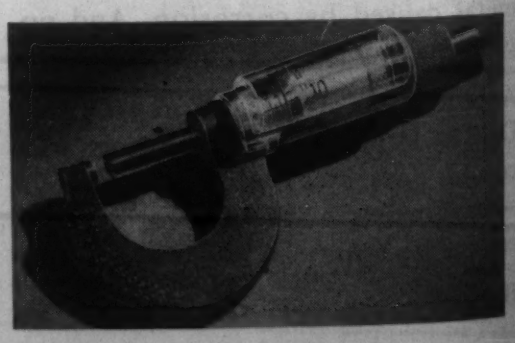
However, the Bureau has done metallurgical research involving electronic devices in ore dressing, hydrometallurgy, pyrometallurgy, and electrometallurgy, and there are a number of instruments that are widely used in these four fields. Among them are electrostatic separators, automatic furnace controllers, induction furnaces, rectifiers, microscopes and X-ray diffraction units. In associated chemical work such apparatus as titrimeters, conductivity bridges, colorimeters, and polarographs employing electron tubes are used.

A copy of the report may be obtained for 10 cents by writing to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for Bureau of Mines Technical Paper No. 661, entitled "Electrical Devices Applied to Metallurgical Research," by E. V. Potter.

● A portable fluorescent work light, "Tube-A-Lite," is announced by the *Larrimore Sales Co.,* Box 1234, St. Louis. It carries two to three 6-watt 9-in. fluorescent tubes arranged in a circle around a central supporting laminated plastic tube. A separate mechanical type starting switch goes with each tube. The housing is of Formica laminated plastic (except the transparent Lucite envelope). It operates on 110-v., 60 cycles. The switch end serves as a handle for carrying like a flashlight. Or it may be hung to a hook with a break type ring.

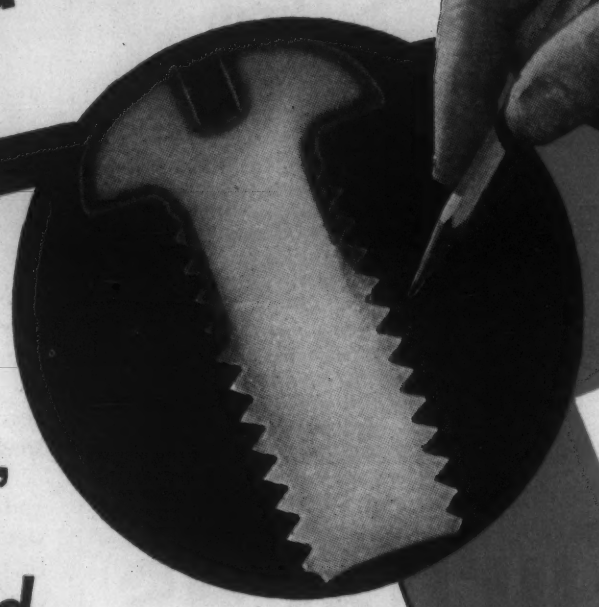
Magnifier of Micrometer Scale

A device that magnifies the scale on the micrometer for the person with weak eyesight or in places where light is dim, is called the "Magna Eye."



It is made by the *Stebar Co.,* 711 W. Lake St., Minneapolis 8.

Now you can carburize selectively in liquid baths!



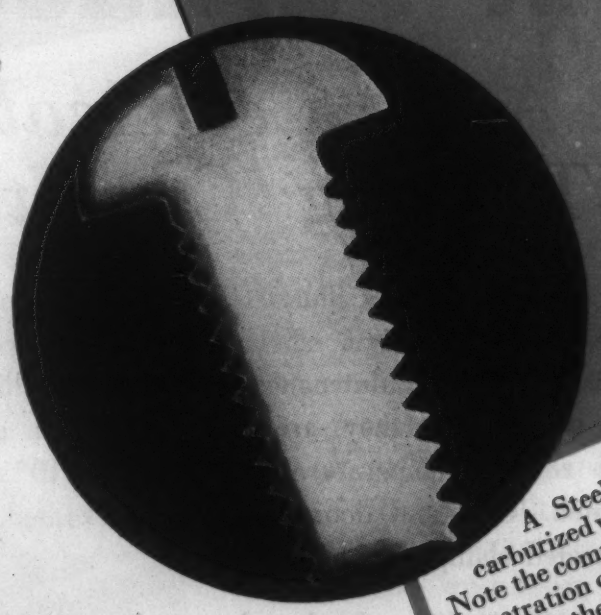
An example of selective carburization with "NO-KASE". Note the clear cut line of demarcation between the protected and unprotected areas. (Treated in PARK-KASE for 3 hours at 1600° F.)

Park

"NO-KASE"

(Patent Applied For)

A new kind of stop-off paint



A Steel bolt selectively carburized with "NO-KASE". Note the complete lack of carbon penetration on the protected section of the bolt. (Treated in PARK-KASE for 3 hours at 1600° F.)

Park "NO-KASE", a new development in stop-off paints provides positive protection against carburization in liquid carburizing baths. When you apply "NO-KASE" even the most difficult sections, such as threaded edges (see photograph at right) are protected from carburization.

Park's "NO-KASE" is applied as paint and is easily confined to the area where protection is desired. Because it is quick drying "NO-KASE" can be immersed in the carburizing bath approximately one hour after the part is painted.

The vehicle of "NO-KASE" paint burns out when subjected to the heat of the bath, thereby leaving the pigment as a continuous metallic coating.

SEND IN YOUR ORDER FOR "NO-KASE" TODAY OR WRITE FOR PARK BULLETIN E-16 WHICH GIVES YOU COMPLETE INFORMATION AND PRICES

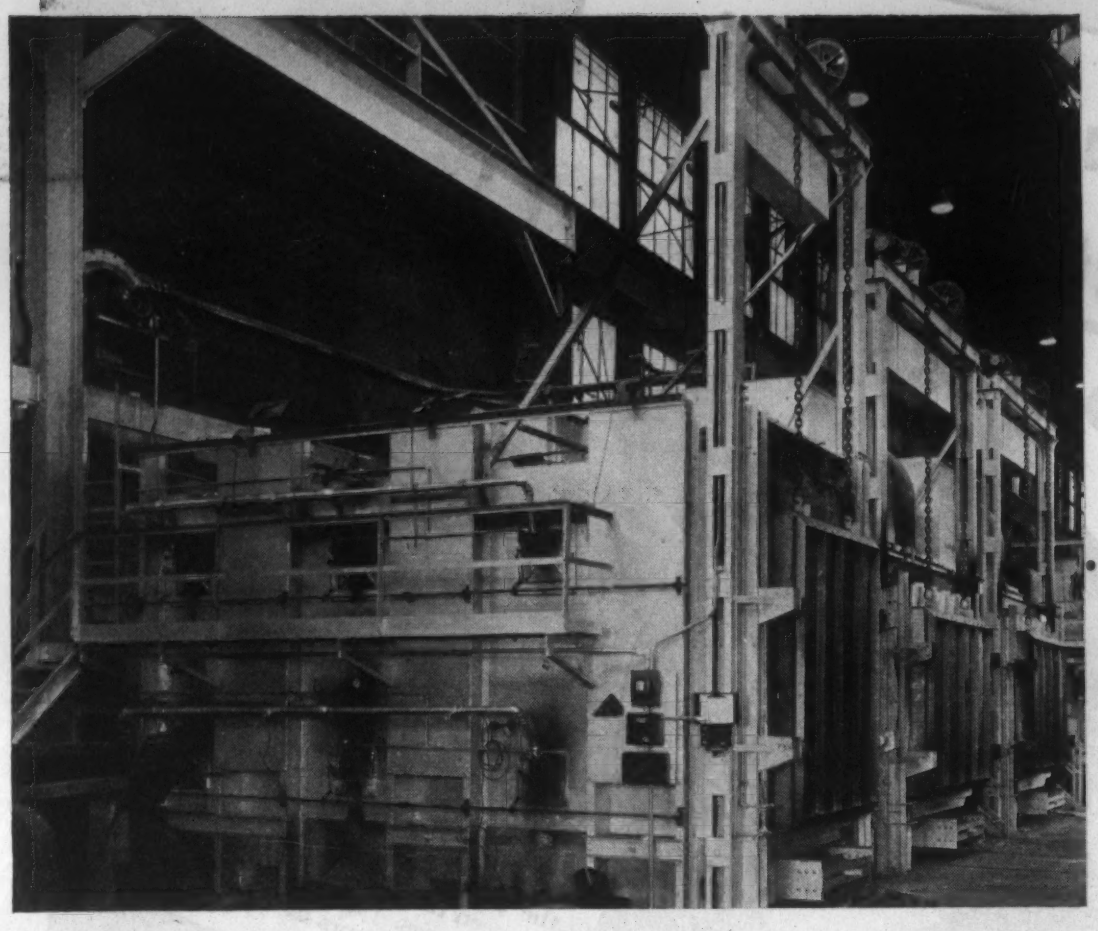
Park

PARK CHEMICAL CO.

DETROIT . . . MICHIGAN

Liquid and Solid Carburizers ☆ Cyanide, Neutral and High Speed Steel Salts ☆ Lead Pot Carbon ☆ Charcoal ☆ Coke ☆ No Carb. ☆ Carbon Preventer ☆ Quenching and Tempering Oils ☆ Drawing Salts ☆ Metal Cleaners ☆ Liquid Grain Cement.

8074 MILITARY AVE. DETROIT, MICH.



VULCAN Furnaces

For Fast, Accurate Heating and Heat Treating Operations

The battery of three Car Hearth Furnaces illustrated above is typical of all VULCAN installations in advanced design, efficient, high-speed heat treatment, and economical operation and maintenance. Used for handling miscellaneous forgings and weldments, they are oil fired, with complete automatic control in two zones. Temperature uniformity of 10° plus or minus is readily maintained. Cars and doors are motor operated. Doors are equipped with air operated clamps for sealing.

Furnace No. 1, in foreground, is direct fired and used for annealing and normalizing at maximum temperature of 1700°.

Furnaces No. 2 and No. 3 are convection heated and are used for normalizing at temperatures up to 1250°. Each is equipped with two high temperature fans.

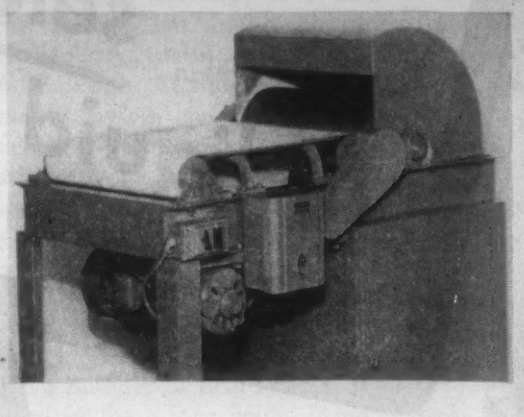
An imposing list of installations demonstrates the important part allotted to VULCAN Furnaces in the Nations' war effort, and of the high measure of success attending it.

Although each VULCAN installation is engineered to meet specific requirements, the cost is generally no greater than for standardized equipment. Let us quote on your requirements.

VULCAN CORPORATION
1791 CHERRY STREET, PHILADELPHIA, PA.

Metals, Etc. Disintegrator

A new invention disintegrates almost any metal into a small multi-fractured chip that can be converted to a fine powder with one Hammermill operation. Cast iron and certain other metals it reduces to a fine powder without the Hammermill.



Manufactured by the *Franklin-McAllister Corp.*, Suite 800, 135 S. La Salle St., Chicago 3, and invented by M. C. Rawson, the materials that it has disintegrated successfully range from nickel and stainless steel to wood, rock wool, etc.

The feed mechanism regulates the feed and can be adjusted to various speeds and size of powder, grit or shred. The company lists tentatively 41 products that the device can handle, starting with magnesium and ending with corn cobs.

● In a study of the explosive and inflammable characteristics of powders used in the manufacture of plastics, it was found that out of 57 powders examined, all but three could be ignited when brought in contact with a heated surface of sufficient temperature. Many plastic powders were only slightly less explosive than magnesium. Further information is available from the *Bureau of Mines*, Washington 25.

Two Outdoor Welders

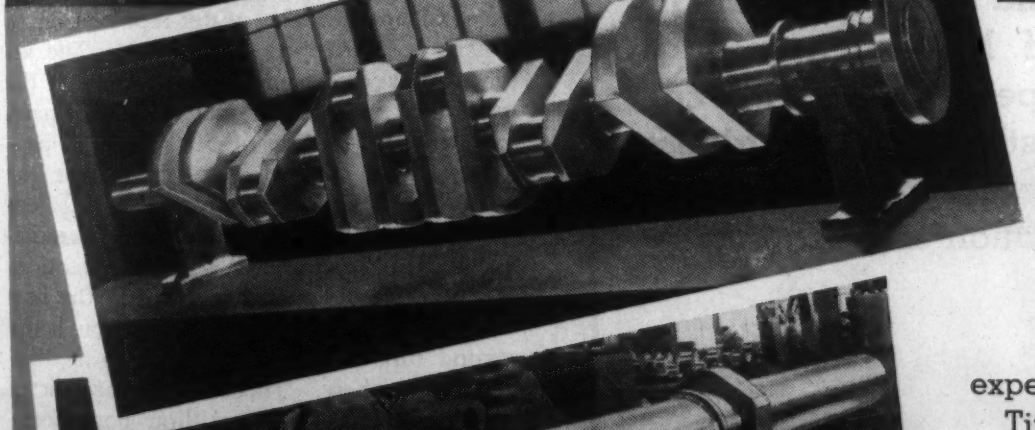
Two new outdoor a.c. welders, a 500-amp. type and a 300-amp. model, have been brought out by the Electric Welding Div., *General Electric Co.*, Schenectady. Ranges are 100 to 625 amp. and 60 to 375 amp., respectively. They are designed for shipyards and other outdoor sites.

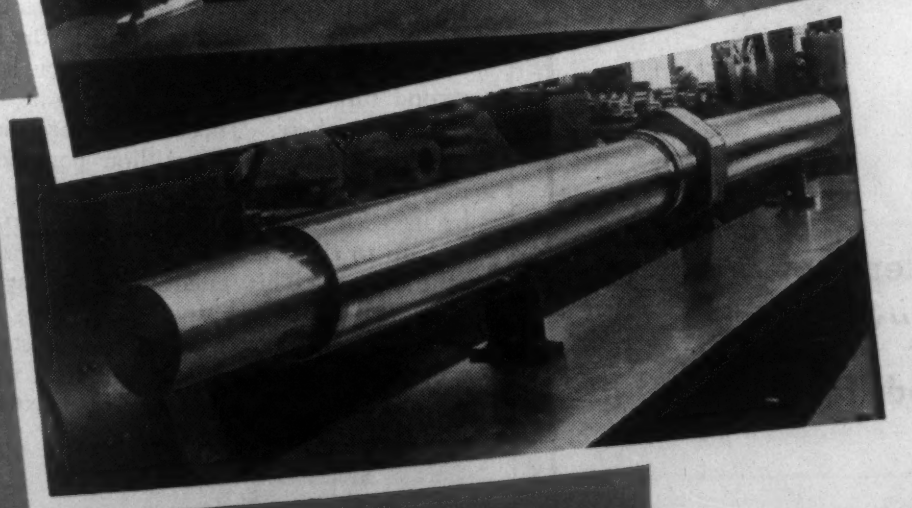
An "idlematic" control reduces the output voltage automatically to less than 30 volts whenever the arc is not in operation, yet provides full power for welding, directly the arc is struck. A handle projecting through the top of the case operates a switch for shutting off the welder when not in use.

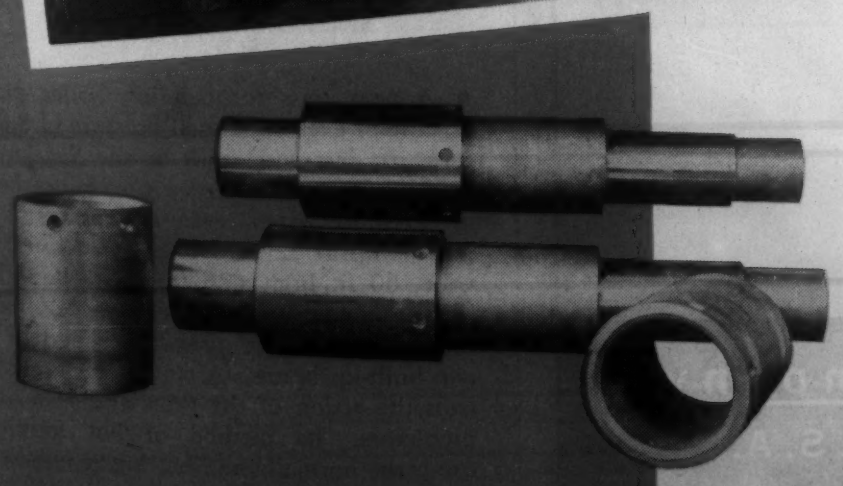
All openings are drip-proof, with a sealed window over the current indicator. Ventilating openings shed water and keep air velocity low. A special finish on internal parts protects against corrosion. Among the many features are: built-in power-factor improvement, fingertip adjustment, stepless current control and fan-forced ventilation.

When it's a TOUGH FORGING JOB call on—

TITUSVILLE







When your specifications call for quality FORGINGS to the most minute tolerance—look to TITUSVILLE—an organization of master craftsmen with more than 50 years experience in exacting forge technique.

Titusville engineers will gladly cooperate with you NOW, in planning present or post-war applications for Quality FORGINGS,—utilizing to the fullest extent the newly developed steels and alloys combined with modern production methods and facilities.

STRUTHERS WELLS CORPORATION

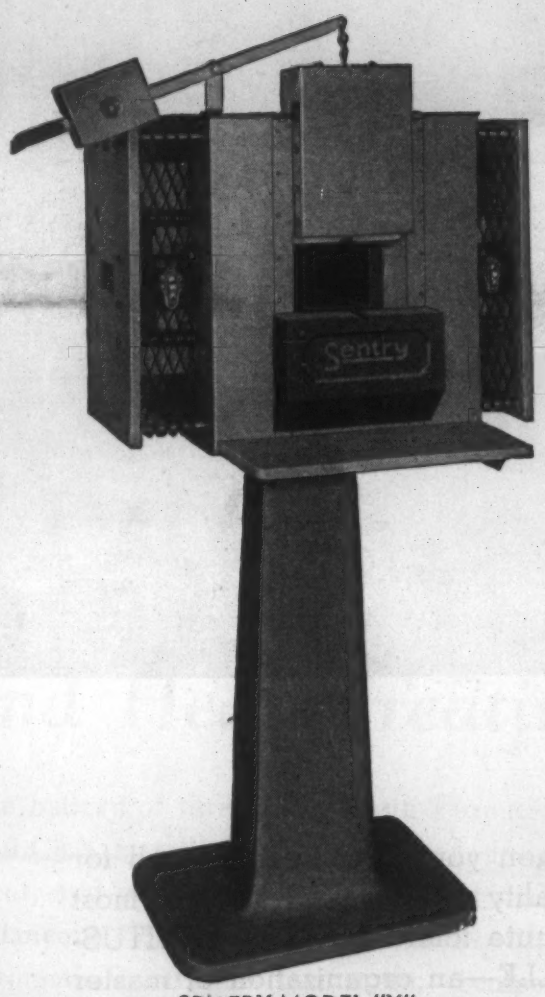
ARMY E NAVY

TITUSVILLE FORGE DIVISION

PLANTS AT TITUSVILLE, PA. AND WARREN, PA.

Offices in Principal Cities

More and More Sentry Furnaces!



SENTRY MODEL "Y"
High Speed Steel Hardening Furnace

The demand for Sentry Model "Y" Diamond Block Furnaces is now greater than ever before.

WHY?

Because Sentry Model "Y" Furnaces and Sentry Diamond Blocks offer the most Simple and Economical means of hardening High Speed Steel with consistent high hardness, freedom from decarburization and scaling.

If you have High Speed Steel to harden, you will want to avail yourself of a Sentry Model "Y" Furnace and The Sentry Diamond Block Method for Hardening High Speed Steel.

WRITE FOR BULLETIN 1020-1C

The Sentry Company
FOXBORO, MASS., U.S.A.

• New production equipment has enabled *Jessop Steel Co.*, Washington, Pa. to furnish light gage stainless-clad steel sheets. Thicknesses from Nos. 16 to 12 gage can now be produced in widths from 24 in. to 50 in. and up to 96 in. long. Polished sheets are available up to 48 in. wide. Twenty per cent of the total thickness is stainless steel.

Moisture Remover from Air and Gas

For automatically and continuously removing condensate in the form of droplets, slugs or mist from compressed air and gas lines, the "Liqui-jector" has been developed by *Selas Corp. of America*, Erie Ave. and D St., Philadelphia 34. It is adaptable on lines up to 1¼-in. pipe size and normal line pressures.

No moving parts are involved and no cocks, traps or shut-offs are needed in the drain line. Action is entirely automatic and continuous through two porous ceramic tubes—one inherently water-repellent and the other water-permeable but air-impervious.

It is useful with pneumatic tools, atmosphere gas generators, compressors, air-actuated control systems, vapor quench lines, spray and blast equipment and other pneumatic apparatus. The principle is the separating of liquid and gas phases by virtue of the surface tension of the liquid.

Entering the Liqui-jector, compressed air passes through the water-repellent tube where it is stripped of moisture. The action is by coalescence of droplets on the surface of this tube, a coarse ceramic material with an average of 50,000 pore openings per sq. in., each so small that the pressure drop across the tube is insufficient to permit water passage against the resisting diaphragm-action of its surface tension.

The coalesced moisture drops to the bottom of the unit where it passes through the second tube (without loss of air) to outside atmosphere. This tube is of microporous porcelain, 720 million pore openings per sq. in., and (being constantly wet by its wick action) constitutes a perfect air seal up to the rated limit working pressure of the unit. This rated pressure may be manipulated to user specification.

Its oval shape permits flush-against-the-wall installation, directly in the line, without the addition of elbows or other fixtures.

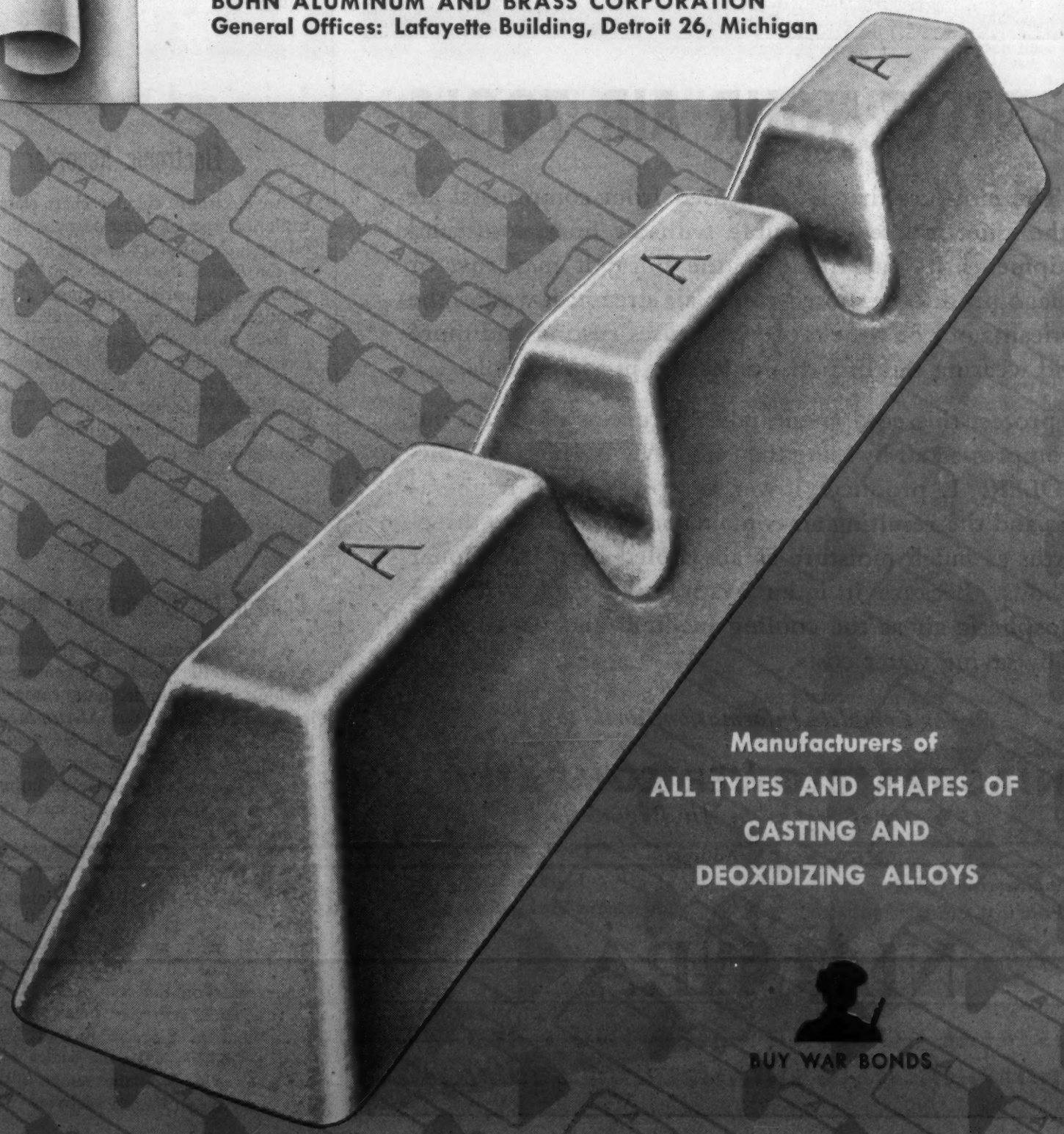
• A new press for bending boiler plate, capable of exerting a total pressure of 8,800 tons, has just been built by the *Southwark Div., Baldwin Locomotive Co.* It can bend up to 6 in. or more in thickness and in lengths up to 42 ft. Dimensions are 60 ft. wide, 60 ft. high (26 ft. of which is below ground). It consists of two 4,400-ton, four-post hydraulic presses, connected by two built-up beams. A single operator controls the action of the press and plate manipulators. Its method of hot forming, using the normalizing heat, has reduced the time over cold forming by over 34%.

Uniform Castings Begin with Uniform Ingot

Uniform castings mean castings produced at lowest cost, with a minimum of lost motion and spoilage. And uniform castings cannot result, unless you start with uniform ingot. That's exactly the kind you get when you buy from Aluminum Refiners. Over a quarter century of experience enables us to produce ingot to your most exacting specifications—that will cut costs for you and increase profits!

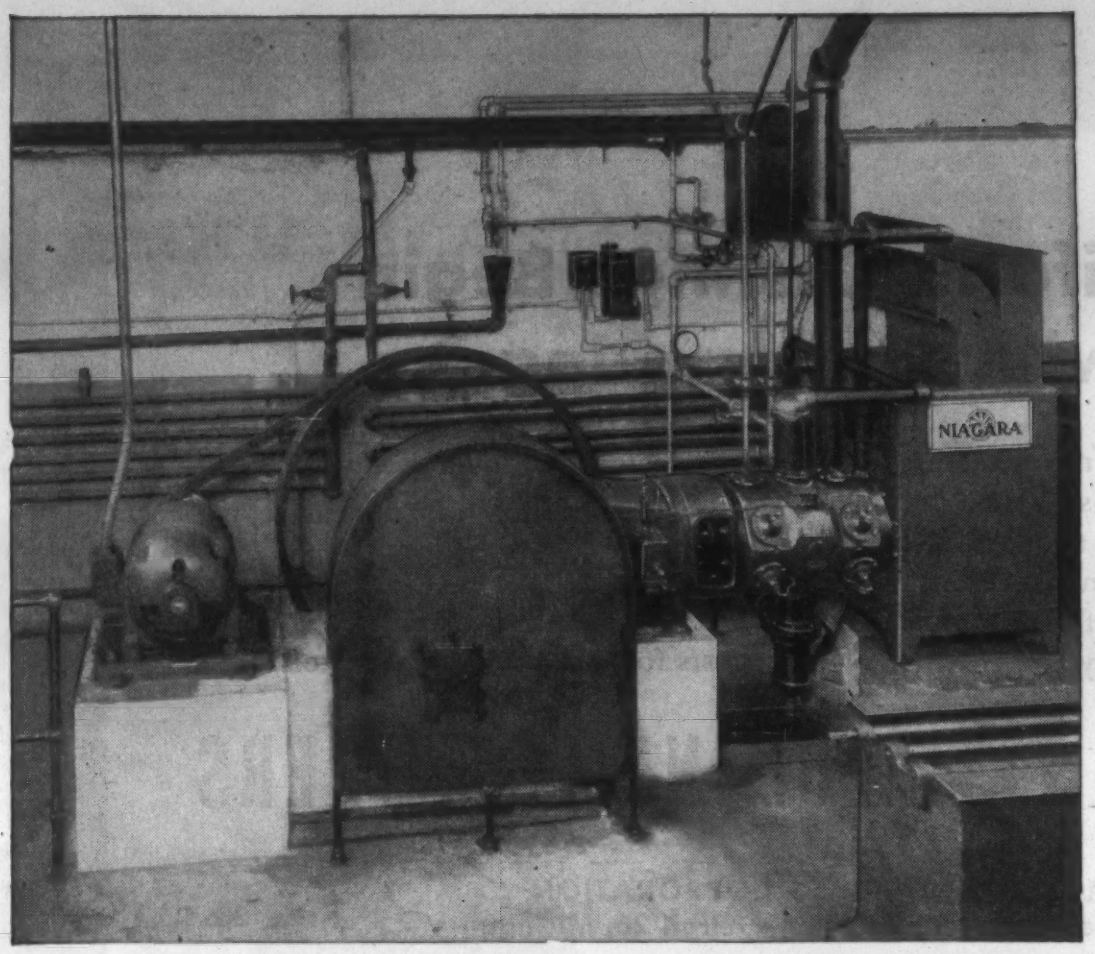
ALUMINUM REFINERS

Division of
BOHN ALUMINUM AND BRASS CORPORATION
General Offices: Lafayette Building, Detroit 26, Michigan



Manufacturers of
ALL TYPES AND SHAPES OF CASTING AND DEOXIDIZING ALLOYS

BUY WAR BONDS



PROTECT YOUR AIR TOOLS

● The moisture that is condensed from compressed air is the chief source of trouble with air lines, tools and equipment. It may freeze in the lines; it may rust or damage products exposed to the air stream; it washes the lubricants out of your tools and causes rusting and more rapid wearing out of parts, especially in rotary tools.

To protect this equipment, take the excess moisture out of compressed air by using the NIAGARA *AERO* AFTER-COOLER. It produces lower compressed air temperatures and the resulting air contains only one-half to three-fourths as much moisture as air cooled by conventional methods. Because it is an evaporative cooler, it uses atmospheric air as the cooling medium and pays for itself by saving water costs.

For Complete Information, write to

NIAGARA BLOWER COMPANY

"25 Years of Service in Air Engineering"

NEW YORK Address: Dept. MA-84
6 E. 45th Street,
New York-17, N. Y.

Field Engineering Offices
in Principal Cities

NIAGARA

INDUSTRIAL COOLING • HEATING • DRYING
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Improved Copper Plating Process

An improved high speed copper plating process that reduces costs and increases speed, substituting potassium cyanide and other potassium salts for sodium cyanide, is announced by *E. I. du Pont de Nemours & Co.,* Wilmington 98, Del. Though the potassium cyanide is costlier, pound for pound, than the sodium salt, a smaller amount suffices to maintain the plating bath at the required strength.

Makers of tanks, planes, motorized equipment and other military items now use it for plating the unmerous engine parts and other items needing copper. It is especially important as a stop-off or mask in selective case hardening of steel parts.

The ease with which it can be buffed compared with steel cuts costs and speeds up production of highly polished articles. The original duPont process was developed in 1938. But now desired thicknesses of deposit are acquired in an even shorter plating time, greater current densities being tolerated by the new bath. This bath is more stable and easier to rinse. The new process reduces the size and cost of equipment.

Electronic Recorder

An electronic circular chart electric controller, of special interest to the metallurgical and chemical industries, is announced by the *Brown Instrument Co.,* Philadelphia precision industrial instrument division of Minneapolis-Honeywell Regulator Co.

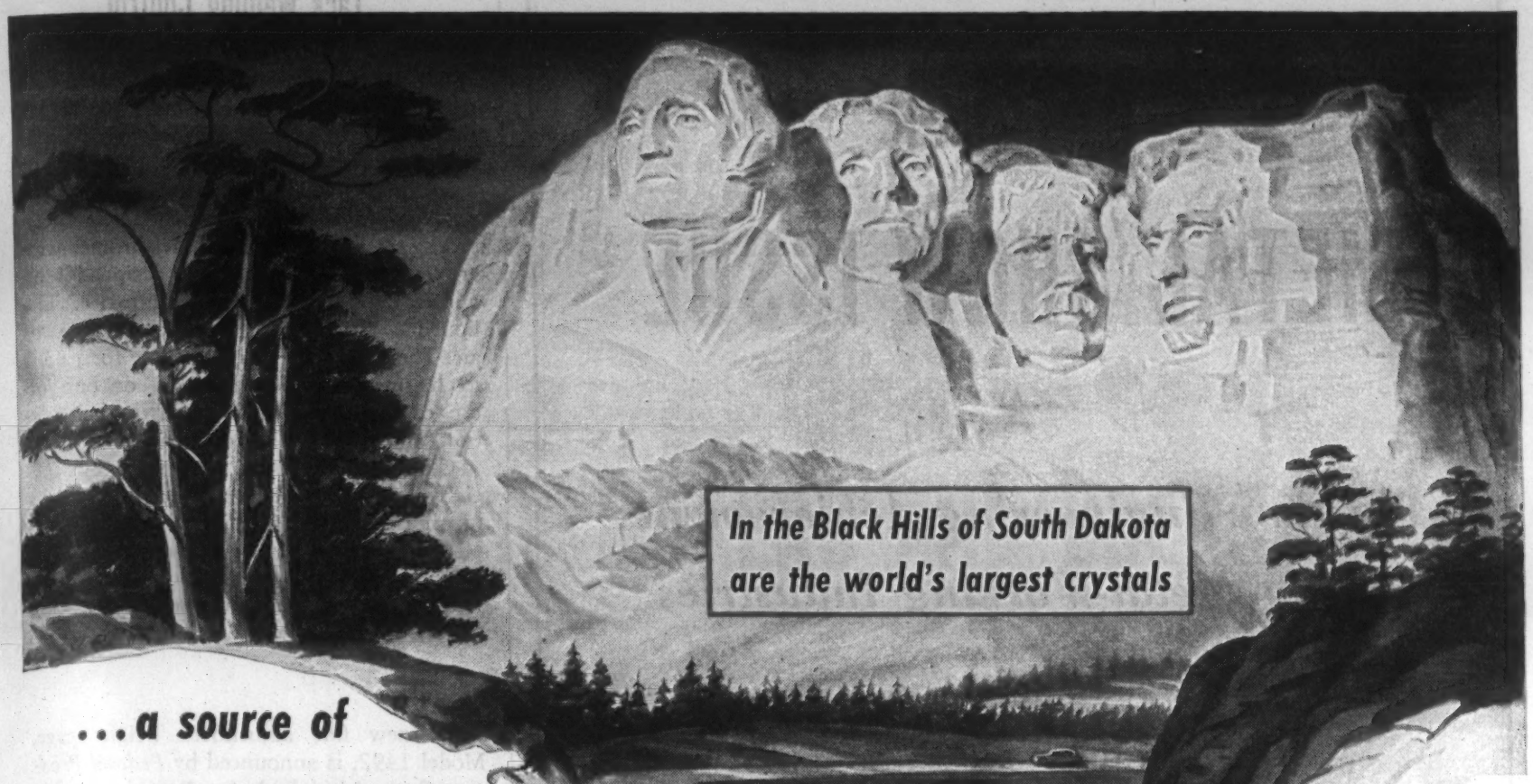
Each model will have several new features, including a control point index which is in red and of the same general shape as the black temperature pointer. This is being released in quantity and with no rationing involved.

Control for Compressor Operations

A new instrument that combines seven devices for the control of compressor operations into a single, neat, compact unit, is announced by the *Electro-Mechanical Div., Manning, Maxwell & Moore, Inc.,* Bridgeport 2, Conn. It eliminates the necessity of using pipe and pipe fitting, simplifying installation, and reduces the possibility of air leakage.

Called the Ashcroft "Compressor-Trol," it is made in three sizes, ½ to 1¼ in., the sizes being determined by the inlet connection. It is designed to cover all requirements of tank mounted compressors up to 15 h.p., or 60 cu. ft. per min.

A muffler on the compressor discharges into the tank, acting to break up the discharge and to disperse the air, insuring adequate mixing with the cooler gases in the tank to reduce the temperature and moisture content before delivery.



In Rushmore National Park, the Immortals of America look down upon a vast area of rich mineral deposits. Buy War Bonds now and, when peace comes, visit this scenic section of South Dakota.

...a source of

LITHIUM

...a metal that has revolutionized HEAT TREATING OF STEEL

Lithium disassociates water, liberating hydrogen which burns with the characteristic scarlet flame of Lithium. The oxygen combines with Lithium to form harmless Lithium oxide.

IMAGINE crystals thirty to forty feet long, weighing over fifty thousand pounds! These are crystals of spodumene, one of several rich Lithium-bearing ores . . . nature's contribution to good heat treating. Lithium is found in abundance . . . is even present in the smoke from your cigar. Supplies for industrial use are plentiful.

Lithium—the metal itself—is the lightest of all the solid elements . . . so light that it floats on gasoline like a cork . . . so active chemically that it searches ceaselessly for oxygen . . . even tears water apart to satisfy its atomic hunger for oxygen.

Oxygen and water destroy steel

In the high temperatures of heat treating, these destructive agents scale the steel and remove carbon from its surface. Decarburization lowers fatigue values of the metal 40% to 50% and greatly reduces tensile strength—facts long known to steel users.

It is possible to remove some of the water from the gaseous atmosphere before it enters the furnace chamber in which the steel is treated, but this does not solve the problem . . . the pre-dried gas becomes wet again in the heat-treating chamber. Moisture forms from intergaseous reactions . . . water and oxygen come in on the steel . . . air containing moisture seeps in. And . . . this is important . . . carbon dioxide and hydrogen, always present in furnace atmospheres, become violently destructive in the presence of even the slightest amount of water vapor. Obviously then, pre-drying of the furnace atmosphere is not the answer to the heat treater's problems.

Lithium changes all this

Lithium treatment of the gases starts where all other processes stop. It extends the control right into the furnace muffle at the work—the only place where control proves its worth. This important feature is exclusive with Lithium. Lithium vapor, introduced into the atmosphere gases in a simple and efficient manner, not only eliminates every trace of water vapor and oxygen from the gases before they enter the furnace chamber, but continues its drying action throughout the complete passage of the atmosphere through the chamber. Lithium keeps carbon dioxide and hydrogen inactive at all times because it keeps them dry . . . makes it unnecessary to maintain critical equilibria in the atmosphere.

In a Lithium Furnace no atmosphere adjustments are needed to produce bright, decarb-free heat treating of successive batches of steels of different carbon content. Control in bright carburizing is positive, not only at the eutectoid composition but at any carbon concentration below the eutectoid. The process is rapid, economical and without a time-wasting diffusing cycle.

The Scarlet Flame
LITHIUM

Furnaces to fit the job

The trade names are LITHCO for neutral heat treating; LITHCARB for bright carburizing; LITHCARB Carbon Correction for replacement of carbon in decarburized steel. All three furnaces are extensively used in vital war plants. Made in batch, pit, conveyor and other types. Data sent on request.

THE LITHIUM COMPANY

Manufacturers of
Metallic Vapor Atmosphere Furnaces

111 Sylvan Ave. • Newark 4, N. J.

OCTOBER

METAL SHOW ISSUE

★

Wartime Engineering Achievements in the Metal-Working Industries

will be the theme of the

October Metal Show Issue of

METALS and ALLOYS

A complete program of the Metal Show Meetings and a list of Exhibitors also will be featured.

★

ADVERTISING CLOSING DATES

● SEPTEMBER 1—For Space Reservations
(specific colors should be indicated)

● SEPTEMBER 1—For Copy to be Set

● SEPTEMBER 5—For Complete Plates

★

Advertising space will be limited;
Present advertisers will be taken care of;
New advertisers will be taken up to our ceiling only.

REINHOLD PUBLISHING CORPORATION

330 West 42nd Street, New York, N. Y.

Tack Welding Control

A new and improved circuit control panel for tack welding with a constant potential power supply has been placed on the market by *Air Reduction,* 60 E. 42nd St., New York 17. Known as Wilson type special tack welding circuit control, it is simple, sturdy and compact.

The resistors of round Nichrome wire are mounted on insulators, designed well within the permitted temperature rise. The housing provides for full circulation of air. The mounting brackets allow for panels to be mounted side by side, or one on top of another without restricting circulation, and they aid in portability.

Current values are controlled by specially designed contacts and are adjusted by turning fiber handles tight against a copper bus bar to connect the various resistors into the circuit, output current being the sum of the resistors so connected.

• A new fine adjustment height gage, Model 1492, is announced by *Federal Products Corp.,* 1144 Eddy St., Providence. No more "tapping" is necessary when one sets the indicator to the gage blocks or master to the required measurement. It is brought into position positively and yet as lightly as a feather.

Coolant Strainer

A strainer for use over the base intake of immersed centrifugal pumps in grinders, automatic screw machines and other machine tools is announced by *Metal Textile Corp.,* Orange, N. J. It is called the Metex knit wire mesh coolant strainer. Of large surface and depth area, it is designed to enclose the base intake of immersed centrifugal pumps.

The fixture bolts to the pump shaft and centers the strainer which is drawn up on threaded bolts and sealed over the pump intake. The feet or lugs of the pump base casting imbed themselves in the mesh. The large openings in the mesh, in relation to the diameter of the wire from which it is knitted, provide an exceptional measure of capacity to hold chips and dirt without clogging.

The retention of the residue increases the efficiency of the strainer and the action of the moving coolant fluid serves to wash off surface accumulation. They are universal in their application, straining metals and particles from water, oils and emulsions.

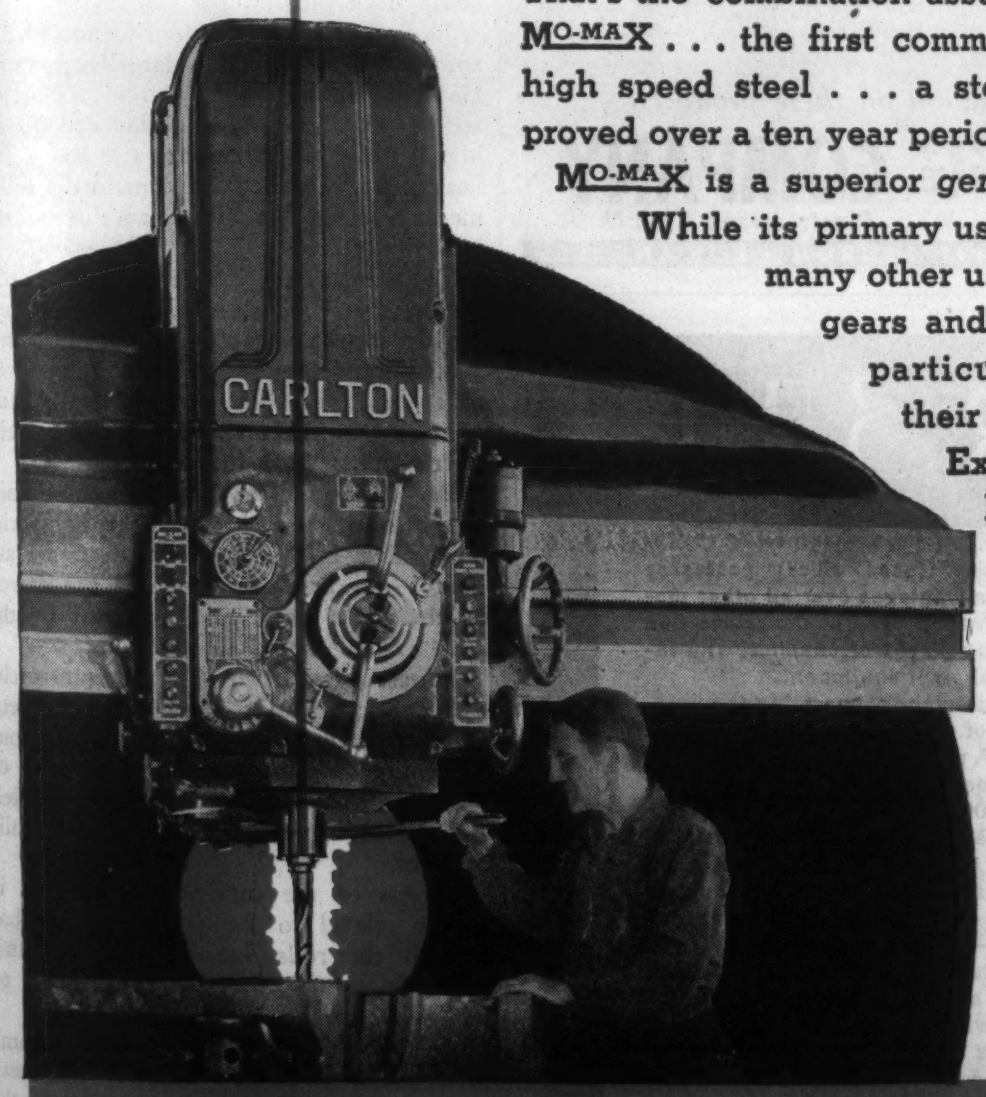
• The *Reduction and Refining Co.* of Newark, N. J., producer of the high purity tungsten metal powder, announces the development of a new process of high purity hydrogen reduced cobalt metal powder and its oxide. Philip Lasdon, the managing director of the Reduction and Refining Co., states that at present they are in a pilot plant operation.

MO-MAX

TRADE MARK REG. U.S. PAT. OFF.

HIGH SPEED STEEL

HAS WHAT TOOLMAKERS AND USERS WANT



Whether you *make* metal-cutting tools or *buy* them for use in your plant, keep in mind that MO-MAX offers the properties you want—great toughness plus a high degree of hardness. That's the combination assured by the basic composition of MO-MAX . . . the first commercially successful molybdenum high speed steel . . . a steel which has been tested and proved over a ten year period.

MO-MAX is a superior *general purpose* high speed steel. While its primary use is for cutting tools, it also has many other uses. It can be used for high duty gears and for wearing parts of machines, particularly those which must keep their hardness at high temperatures. Experienced engineers and metallurgists agree that if a part can be made of high speed steel, it will be *better* if made of MO-MAX. If you *make* tools, ask any one of the prominent steel producers listed below about MO-MAX stocks available today. If you *buy* tools, remember the brands listed.

THEY'RE ALL MO-MAX

"LMW" . . . . . Allegheny Ludlum Steel Corp.	"Molite 8" . . . . Columbia Tool Steel Company	"Tatmo" . . . . . Latrobe Electric Steel Co.
"Mohican" . . . . Atlas Steels, Ltd.	"Rex-T-Mo" . . . Crucible Steel Co. of America	"S. T. M." . . . . Simonds Saw and Steel Co.
"Bethlehem HM" Bethlehem Steel Company	"Di-Mol" . . . . . Henry Disston & Sons, Inc.	"Mo-Tung" . . . Universal-Cyclops Steel Corp.
"Mo-Cut" . . . . Braeburn Alloy Steel Corp.	"Rex-T-Mo" . . . Halcomb Steel Co.	"8-N-2" . . . . . Vanadium-Alloys Steel Co.
"Star Max" . . . The Carpenter Steel Co.	"Mogul" . . . . . Jessop Steel Company	"Vul-Mo" . . . . Vulcan Crucible Steel Co.

TIME AND MONEY ARE S-A-V-E-D WHEN KELLOGG CASTABLES ARE ON HAND

Users of Kellogg Castables—KASTIC and KEL-CRETE reduce furnace shut downs by making their own special shapes, jambs, door linings, baffle walls, ducts, dampers, car tops, etc. by simply adding water to the scientifically prepared Kellogg mixture. No waiting for delivery of special shapes from a distant point.

KASTIC...

KASTIC prepared in two grades—Industrial and Domestic; both with a maximum working temperature of 2600°F.

KEL-CRETE...

KEL-CRETE is light in weight—60-65 pounds per cubic foot with a maximum working temperature of 2000°F.

Write today for bulletins giving information on these products.

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Sales Office: 225 Broadway, New York 7, N. Y. Plant: Jersey City, N. J.

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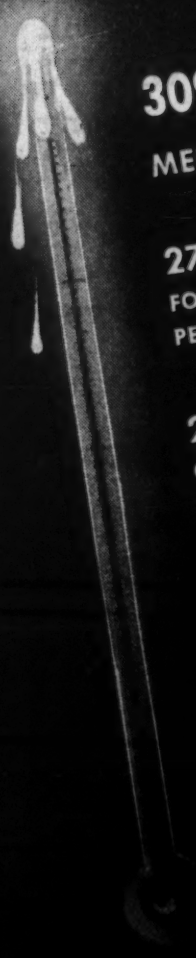
AMERSIL*!



3092°F
MELTING POINT

2700°F
FOR SHORT PERIODS

2100°F
CONTINUOUSLY

COEFFICIENT OF EXPANSION IS 0.000000054 PER DEGREE OF C.

Amersil* (fused silica) possesses many advantages over all other materials when used in the fabrication of many pieces of chemical and industrial plant equipment.

It withstands, operating temperatures of 2100°F. with peaks up to 2700°F. permissible for short periods. Its coefficient of expansion is 0.000000054 per degree of C. over a range of 0° to 1,000°C. This is 1/34 that of copper, 1/17 that of platinum, 1/9 that of tungsten. It is inert to acids, even when hot and concentrated—except hydroflouric (at all temperatures) and phosphoric above 270°F. and is unaffected by the halogens, with the exception of flourine. It does not contaminate the acids handled. It withstands severe thermal shocks, is light in weight and provides unique electrical insulation values.

A new Amersil* Catalog is now on the press. Write today—on your business letterhead, please—and reserve a copy.

*The registered trade name of the only American manufacturer of a complete line of fused silica products.

AMERSIL COMPANY Inc.

A Subsidiary of Nichols Engineering & Research Corp.

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Continuous Induction Hardening of Bars

Continuous high frequency induction heating of steel bars for hardening is announced by *Ohio Crankshaft Co.*, 3800 Harvard Ave., Cleveland 1, a process that promises to have far-reaching effects. Bars inductively hardened reveal improved machinability while heat treatment costs are 50% lower, with an actual saving of $15 per ton possible.

Small lots can be treated as easily as large lots. One has only to push a button to accomplish the hardening. There are greater uniformity of hardness and greater machinability because of elimination of overhard spots.

The process is being applied at the Caterpillar Tractor Co., Peoria, Ill., the company treating bars from ½ to 1¼ in. O.D., hardened through their entire diameter, free of scale and decarburization.

Growth is negligible while the heat treating cost per lineal foot is the same for one bar as for 1000. The bar unit is an adaptation of the method for continuously hardening track pins.

Equipment consists of four identical hardening units and two standard Tocco units. Hardening units, built on rigid cast bases, are 11½ ft. long, 37 in. wide and 38 in. high. Three roller housings rise above this heavy base by 16 in., and contain the roller mechanism for passing the bars through the inductor coils.

The hardening units, set parallel, carry two water-cooled, copper inductor coils, one for hardening, the other for drawing. Spaced between the roller housings, the coils are 17 in. long, with diameter sufficient to treat 1¼-in. bars. A quartz tube liner protects the inductor.

Bars are passed through the heating coils at controlled speed by three sets of special feed rollers in the housings. Rolls are adjustable for bar diameters, and are driven by the same motor and governed by the same variable speed control unit.

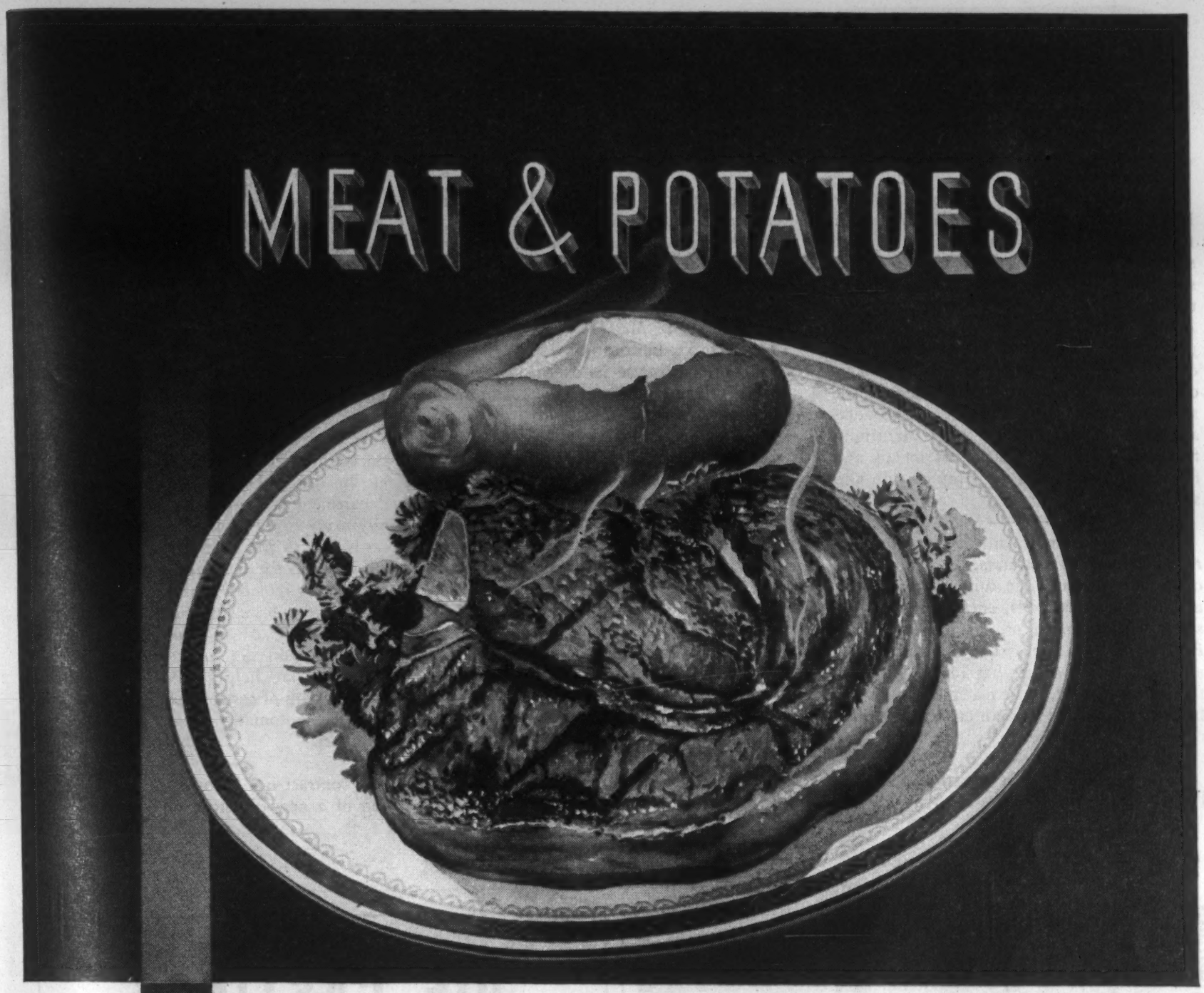
Power is from two standard 9600 cycle, 440-v. Tocco Junior motor generator sets. One, 125 kw. output, operates the four hardening coils in parallel; the other is of 75 kw. for the draw coils, also in parallel. An amplidyne voltage regulator keeps coils constant.

Success of the continuous operation is closely related to the positive drive that governs the rolls, keeping hardness uniform. In a 20-ft. bar, hardness is held to within two points, Rockwell C.

At Caterpillar SAE 1035 rounds comprise majority of bars treated. Hardness averages 28 Rockwell C; yield strength, 112,000 lb., and tensile strength, 129,000 lb. Elongation runs 23%, reduction of area 62% and Izod impact strength 80 to 100 ft. lb.

It can be applied to all hardenable alloys and simple carbon steels. Hexagon and other shapes are treated with but minor change of inductors and rate of feed.

The bars are fed into the treating units over a motorized conveyor which passes them through a sodium phosphate wash before engaging the first rollers prior to the entry into the hardening coil.



Western
BRASS
PRODUCTS
WESTERN CARTRIDGE COMPANY
EAST ALTON ILLINOIS U.S.A.

Before the war we accepted big, juicy steaks as a part of our everyday lives. We ordered them... got them... and enjoyed them, without a thought of the day when a steak might be a rare treat.

The same thing happened to Brass, Bronze and Copper. For years these metals met the exacting requirements of peacetime industry. Then, to crush the vicious forces of would-be world rulers, American industry converted for war.

The need for Western metals necessitated stepping up our production time after time in our mills at East Alton, Ill., and New Haven, Conn. Exacting specifications were met and are continuing to be met so that the fighting men of the Allied Nations will have all the ammunition and other tools of war that they need.

Possibly Western metals can help you in meeting war requirements now and peacetime requirements later on. We will do everything we can to meet your specifications ... *now and later.*

Western **BRASS MILLS**

Division of WESTERN CARTRIDGE COMPANY, *East Alton, Ill.*

BRASS • BRONZE • PHOSPHOR BRONZE • NICKEL SILVER • COPPER

News of Men, Societies, Meetings and Companies

Plants and Slants

A plant that recently received the Army-Navy "E" has played an important role in four American wars. In the Civil War its salt works were the main source of salt supply for the Confederate forces. We refer to the Saltville, Va. plant of the *Mathieson Alkali Works.* This was the first alkali plant to be established in the South, production having begun on July 4, 1895. Two of its most important products are caustic soda and soda ash. Some of its products are used for the production of aluminum for planes, for heat treating of metals and for refining and desulphurizing of iron and steel.

The new tungsten plant of *Sylvania Electric Products* at Towanda, Pa. is now in operation, turning out tungsten chemicals and tungsten seal rods, employing 150. It starts with tungsten ore, furnished by the *Federal Metal Reserves Corp.* A $100,000 addition, 19,000 sq. ft., has been built upon the previous plant, to be occupied by offices, inspection, finishing, maintenance and machine shop departments.

A new plant has been constructed on the Pacific Coast by *Ampco Metal, Inc.,* Milwaukee 4, to produce its metal by both the centrifugal and sand cast process. It is located at 30 E. Burbank Blvd., Burbank, Cal. Extruded and other wrought products will be stocked there.

The *Reynolds Metals Co.* has bought the 14-story office building at 19 E. 47th St., New York, to house its executive staff and New York sales offices for its aluminum products.

Absenteeism at the Buffalo shell plant of the *American Car & Foundry Co.* has been reduced by 10 to 12% through a novel plan. On each machine is a plywood sign, on which is placed a daily card. Late in the day the worker checks whether he intends to be present next day. Cards are collected an hour before closing time. Men signifying intended absence are approached by foremen who try to persuade them to stay on the job. Those who break promises are called before a Board, which gives the worker a serious pep talk.

Mec-Rad Div., Black Industries, is constructing a new building, adjacent to the present plant at 1400 E. 222nd St., Cleveland, to be devoted to the manufacture of mechanical and electrical components for radionics. The addition is doubling the productive capacity and will contain enlarged laboratory, testing and research facilities.

A low absentee rate of 1½ to 2% at the *Lincoln Electric Co.,* Cleveland, is attributed to its incentive system under which factory employees are able to earn over $5000 a year. An employee picks up his time card on entering the plant but does not ring in at the gate. He carries his card to his department where he rings in when actually ready to go to work. After 20 min. all cards still in the rack at the main entrance are taken to the personnel office. Each card removed is replaced with a red card. When the worker shows up finally he must hand in the red card at the personnel office before he can get his regular card. The interviews are helpful. Moreover the 20-min. pick up of cards gives the management a quick automatic check on the day's absentees.

A contract has been let for the construction of a new one-story office section addi-

An Exceptional Opportunity for Research Scientists

One of America's largest organizations engaged in conducting research for industrial corporations and governmental agencies is expanding its present staff of 300 people.

Research-minded engineers and scientists, who can measure up to this organization's high standard, are invited to investigate the wartime and postwar opportunities of the Armour Research Foundation.

Important work of challenging interest is open to scientists in the following fields:

Physics	*Automotive Engineering*
Chemistry	*Chemical Engineering*
Metallurgy	*Electrical Engineering*
Ceramics	*Mechanical Engineering*
Electronics	*Civil Engineering*

Men and women who can be released from present duties and meet the above qualifications are assured salary and opportunity commensurate with ability. And, future research commitments promise postwar permanence. If you are interested, please write immediately.

Applications are also invited from scientists who are on leave of absence from educational institutions for the duration.

ARMOUR RESEARCH FOUNDATION
32 West 33rd Street, Chicago 16, Illinois

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DIE CAST DIES

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UNIVEX DIE CAST & ENG. CO.
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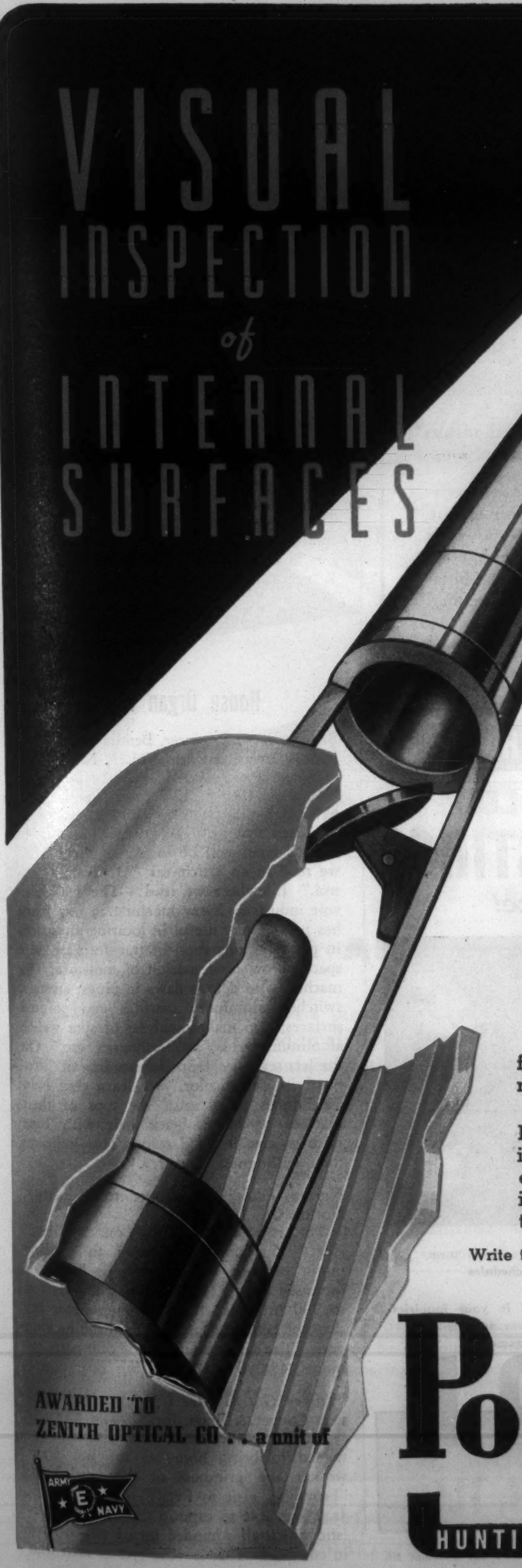
VISUAL INSPECTION of INTERNAL SURFACES

with

POLAN BORESCOPES



For work in which the inspection of internal surfaces is a factor, Polan Borescopes give detailed, minute inspection.

Requiring no special operator training, Polan Borescopes are practical in usage. Designed for inspection of gun bores, bored engine shafts, cylinders, etc., with absence of eye fatigue. Efficient inspection of bore diameters ranging from 20mm to 9 inches; lengths up to 30 feet.

Write today for your copy of Borescope Bulletin No. 507.

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ARMY E NAVY

Polan *Industries*

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IF THERE IS A FLAW
"FLASH-O-LENS"
WILL FIND IT!

The new FLASH-O-LENS offers foundry-men, machinists, and many others engaged in producing metal parts for war contracts an efficient, economical means of examining the most minute defects during routine inspections.

FLASH-O-LENS consists of a portable 40x microscope combined with a perfect source of illumination in one convenient, compact unit . . . They are available in several models—powered by either standard flash light dry cells or by current from any AC or DC outlet—and with a selection of various combinations of lenses, all interchangeable in the one lens housing.

Send today for illustrated catalog describing the new FLASH-O-LENS

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Manufacturers
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PERMANENT MOLD
ALUMINUM CASTINGS
A Complete Service!

Design
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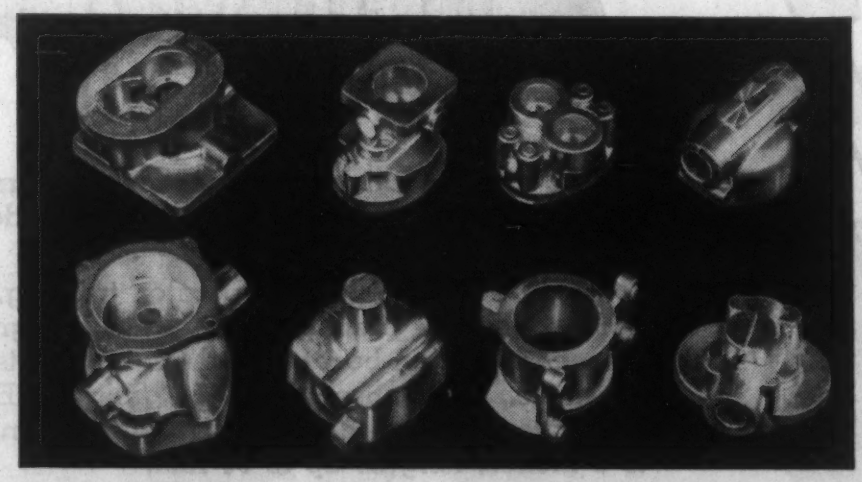


Permanent Molds manufactured

Heat Treated to all specifications

Deliveries to meet all schedules

Aluminum Castings produced in any quantities

X-Ray and other inspection controls

Send in your inquiries for war and civilian requirements

NATIONAL
ALUMINUM MFG. CO., PEORIA, ILL.

CHICAGO 1424A, Merchandise Mart DETROIT 8-254 General Motors Building BUFFALO 837 Potomac St.

tion to the main plant of the *Kelley-Koett Mfg. Co.*, Covington, Ky. The company makes X-ray equipment and has subcontracts for assemblies for aircraft.

Sugar catches more flies than vinegar and a smile often preaches a lesson more effective than a frown, reasons the *White Motor Co.*, Cleveland 1. It has reduced accidents effectively through a series of cartoons or posters posted throughout the plant. As an official states, "the campaign was considered a big success from every standpoint." A typical cartoon shows a porter trying to lift a box, but with his legs straight and his rear very prominent. "Hey, bend your knees—who do you think you are—Hercules?," yells a wise guy (who happens to be right).

The business of the *New England Drawn Steel Co.*, Mansfield, Mass., is being taken over by *Bliss & Laughlin, Inc.* and hereafter operated as the *New England Drawn Steel Div. of Bliss & Laughlin, Inc.*, under the direction of Harold L. Sherwin, who continues as general manager.

House Organ Notes

Bendix Radio Engineer, Bendix Radio Div., Bendix Aviation Corp. Vol. 1, No. 1.

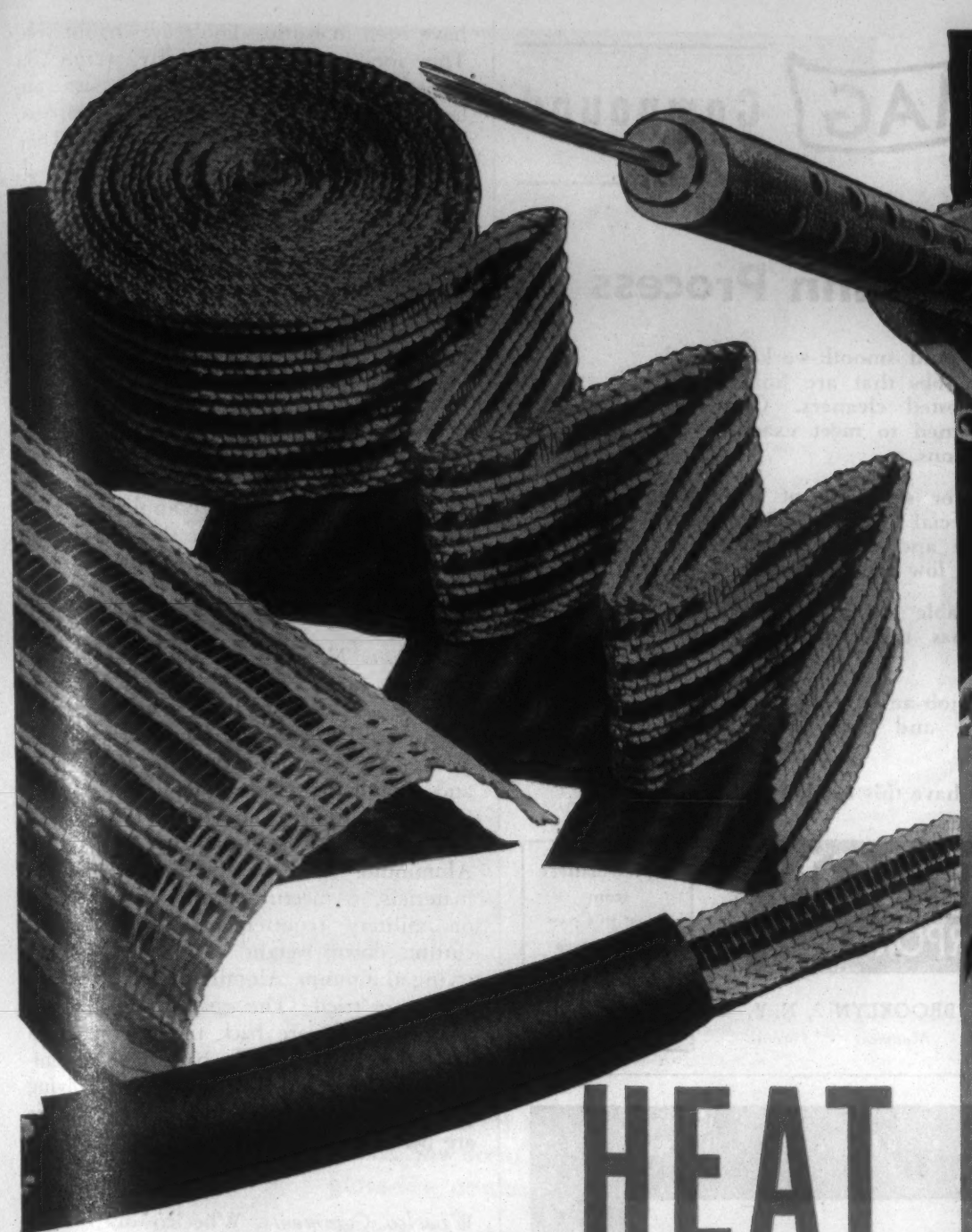
We salaam a new 33-page house organ. Where do they get the good paper? (We have to use a 40-lb. stock.) "It has been predicted that by 1950, 500,000 aircraft of various types will be in use in the U. S.," we read in an article on "Air Traffic Control." Elsewhere we read: "The 150 kilovolt industrial X-ray machine in our plant has proved very useful in locating air spaces in pitch impregnation of transformers. Air spaces allow condensation of moisture. The machine also detects flaws in plugs, crystals, switches, aluminum castings and painted surfaces; also makes analyses of spot welds, aluminum welds, shock mounts, etc." On the less serious side, under heading of "Proposal in Technicolor," we learn that New Caledonian males treat the tops of their thatches of bushy black hair with lime juice to give it a red color. This indicates their willingness to marry.

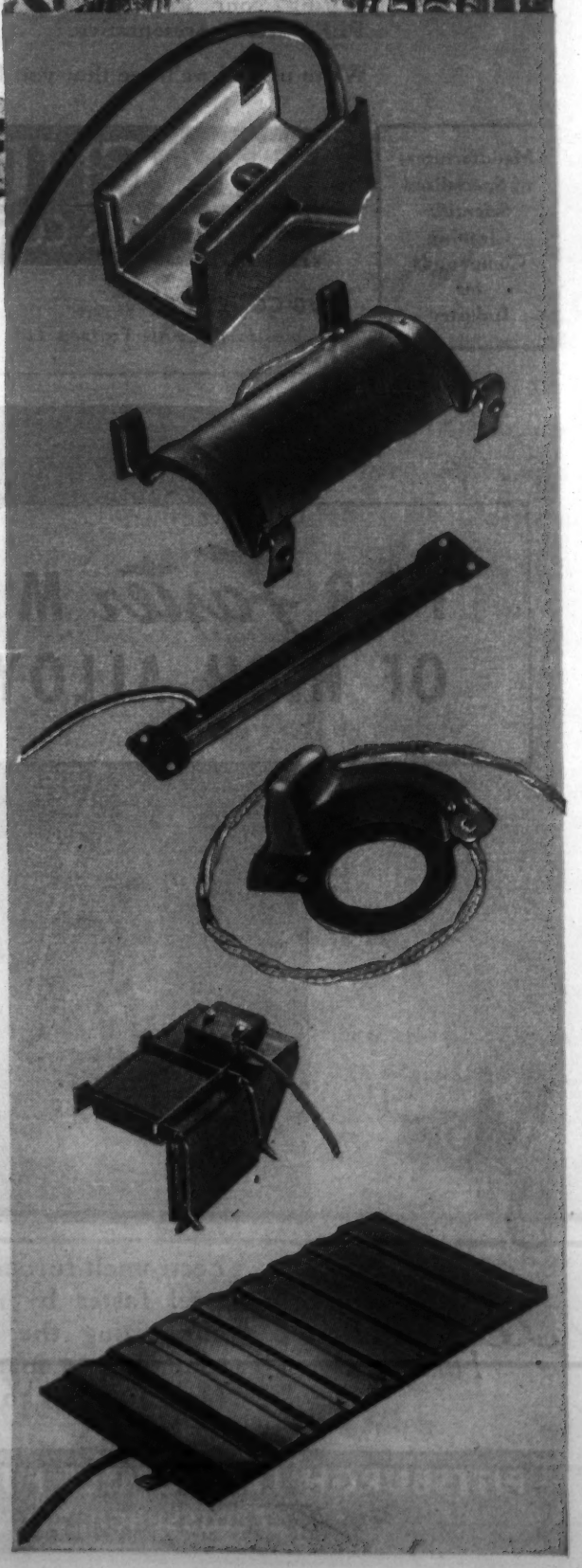
Norton Folks (Contribute to Industry), Norton Co., 1944.

This is a gorgeous book on the "arty" side. "The operating life of an airplane motor between major overhauls has been increased from 420 hr. before Pearl Harbor to 900 hr. today for a bomber motor because of better surface finish on the moving parts. The airplane motor's 8,600 parts requires 45,000 manufacturing operations."

"You've Got to Give Up Something," Revere Copper & Brass, Inc., 1944.

This is a collection of advertisements intended to bring home to the war plant worker the grimness of the battlefront. "From my visit to Pvt. Celester Harnden, Jr. I was able to capture the one characteristic which all wounded men I visited have in common. That is—the eyes of men who





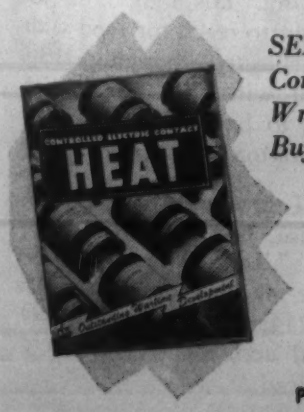
HEAT

AS PLIABLE AS A RIBBON

HEAT . . . as pliable as a piece of ribbon . . . that can be bent, twisted or folded in almost any size or shape, can be designed to fit your contact heating problem.

The H. & A. Electric Contact Heat Unit—a wartime engineering development to prevent freezing of aircraft machineguns at sub-stratosphere temperatures—is adaptable to practically any industrial situation.

H. & A. heaters can be designed for use on pipes, valves, cylinders and containers to maintain exact temperatures in chemicals, oils and other viscous fluids . . . economically, efficiently, safely.



SEND FOR OUR NEW BOOKLET, "Controlled Electric Contact Heat." It may be the answer to your problem. Write: H. & A. Engineering Department, 86 Leroy Ave., Buffalo 14, N. Y.

H & A Manufacturing Co. Inc.

PLANTS IN BINGHAMTON AND BUFFALO, N. Y.

A New PERMAG Compound

used in the Bullard-Dunn Process

- Metal cleaning operations demand smooth-working, and speedy efficiency these days. Jobs that are finished on time, use only dependable tested cleaners. Our new PERMAG Compound is designed to meet exacting requirements in cleaning operations.
- Removal of grease, defilming or stripping of tin from metal parts are done by this special PERMAG Compound with satisfactory thoroughness and in minimum time. Easy to handle, may be used at low concentrations.
- PERMAG Compound is available for plants using the Bullard-Dunn Process, and has the approval of the Bullard Company.
- If yours is a war time cleaning job and you have difficulty getting your work out faster and better, call for a PERMAG representative.

Write us and we'll see that you have this needed help.

Manufacturers of Specialized Scientific Cleaning Compounds for Industry

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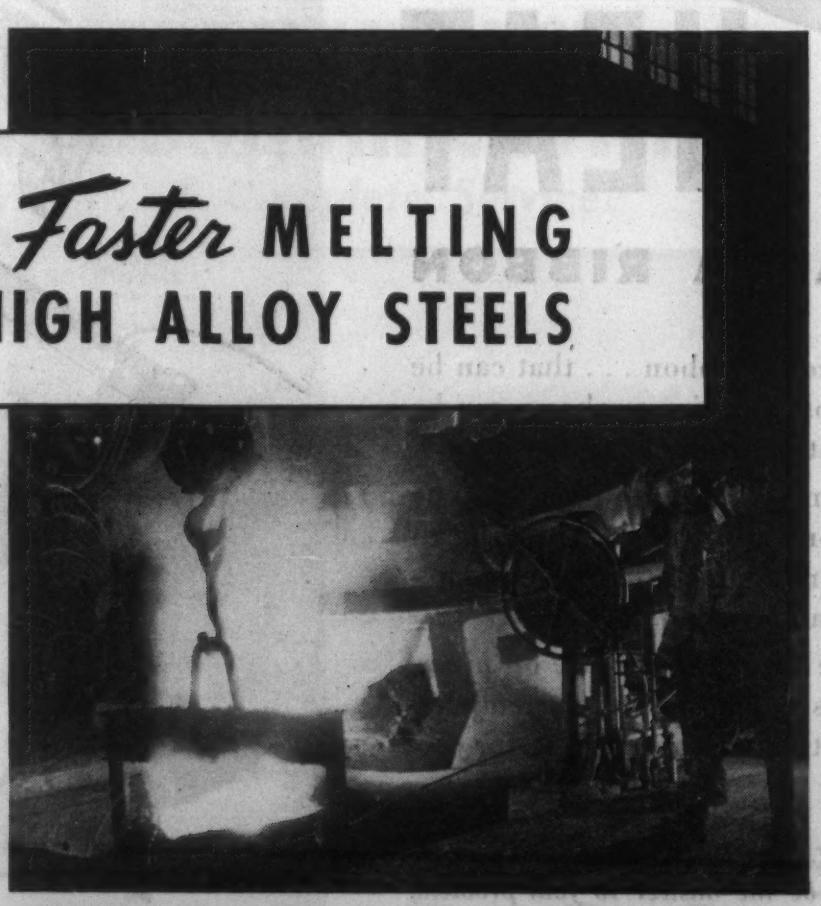
50 COURT ST. BROOKLYN 2, N. Y.

Canadian PERMAG Products Ltd. Montreal • Toronto

Representatives from Coast to Coast Warehouses in Principal Cities

FOR *Faster* MELTING OF HIGH ALLOY STEELS



ARMY E NAVY

MOORE RAPID *Lectromelt* FURNACES

Lectromelt furnaces of the top charge type produce steel faster by reducing the charging time. By minimizing the time between heats, more steel tonnage per man hour is obtained. Sizes range from 100 tons to 250 pounds capacity.

PITTSBURGH LECTROMELT FURNACE CORPORATION

PITTSBURGH, PENNSYLVANIA

have been in battle. Those eyes haunt you. They look at you impersonally, weigh you impersonally and seem to jostle past you, leaving you feeling small and helpless. Those men were of another world. They were pleasant, cheerful, courteous, helpful. But they seemed to feel it was useless to talk to me. They couldn't make me see the battle. They couldn't make me feel the bullets."

Fusion Facts, Stoody Co., Spring, 1944.

Under the topic, "Agricultural Hard-Facing as a Business," we read: "A hard-faced ploughshare will stay sharp about 25 to 30 times longer than an unfaced share. Since unprotected shares can be sharpened a maximum of five times before they are thrown away, one Stoodite application will usually extend the life of a share about five times, and when the deposit finally wears away, the share may be resharpened and rehard-faced with the same results."

Aluminum News-Letter, Aluminum Co. of America, June, 1944.

Here are excerpts from a recent speech of Robert E. Patterson, Under-Secretary of War: "As airborne operations and jungles and mountains present new tactical challenges, equipment undergoes modification and lightness of weight, takes on new values. Aluminum, alone of the three controlled materials, is meeting production schedules on military requirements. Ordnance, in cutting down weight on gun mounts, is trying aluminum. Aluminum cartridge cases are being tried. The quartermaster's stock pots and pans are back in aluminum. In 1945 the canteen will be back there. Aluminum foil and its potentialities in solving packaging requirements for special climates are being investigated."

Wheelco Comments, Wheelco Instruments Co., May-June 1944.

"In the old days of heat treating, temperature control was largely hit or miss. An amusing story concerns an old gentleman who had unusual uniformity in heat treating results. He was very secretive. At length his rivals took him out on a party when he divulged that he always put a potato in the quenching water. Of course the potato had nothing to do with it—he was merely very painstaking in his methods."

Silicate P's and Q's, Philadelphia Quartz Co., Seventh Month, 1944.

"The great anteater is a weird example of specialized equipment. From the point of view of exposing, catching and eating ants, his design seems almost perfect. His strong claws are built for digging, which they do excellently well, but they are a nuisance for walking. His long nose and funny mouth fit him to reach for food without adding to his beauty—though perhaps his narrow-minded wife thinks otherwise. But, applying this to humans—a moderate amount of specialization is valuable."

The Aluminator, Lafayette Works, Aluminum Co. of America, July 7, 1944.

Under topic of "'Land Mines' on Production Front," we read: "From Pearl Harbor to Jan. 1, 1944, 37,600 people were killed in industrial accidents—7,500 more than the military dead."

INDUSTRY'S "PROBLEM CHILDREN" Expertly Handled by DoALL Zephyr!

Developed by the makers of the famous DoALL Contour Machines for faster, cleaner cutting and shaping of today's new materials, as well as some tough old-timers.

- **Magnesium**
- **Aluminum**
- **Non Ferrous Metals**
- **New Plastics**
- **Laminates of all Kinds**
- **For Ripping all kinds of Wood**
- **For Friction Cutting**

VERSATILE

SPEEDY

COURAGEOUS

Is one word for the Zephyr. When equipped with the proper DoALL Saw Band, it cuts its way through anything spongy, flinty, glass-like, porous, any product that presents cutting difficulties.

With a 36" throat, a work thickness capacity of 20" and a 30" square tilting table, the Zephyr accommodates large castings and die blocks as well as parts of unusual length.

Speedmaster equipped, to give instant variable speeds from 1500 to 10,000 f. p. m., jobs can be turned out in one-half to one-third the former time.

Designed and constructed to well-nigh do the impossible, the Zephyr boldly tackles cutting jobs from which other machines shy away.

Yes, you should know more about the DoALL Zephyr. Send for illustrated literature today.

DoALL

INDUSTRY'S NEW SET OF TOOLS

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Sales & Service Offices: Baltimore, Boston, Chicago, Cleveland, Denver, Detroit, Erie, Houston, Indianapolis, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Orlando, Philadelphia, Pittsburgh, Rochester, Rockford, St. Louis, San Francisco, Seattle, Toledo, Tulsa, West Hartford.

HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage** of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:

Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field — less than 1% — with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

Do you have your copy of "AJAX-METELECTRIC PROGRESS," the news magazine of induction melting, electric heat treating, non-ferrous ingot and alloys? Write to: AJAX ELECTRIC FURNACE CORP., 1108 Frankford Avenue, Philadelphia 23, Pa.

* UPWARDS OF 5 BILLION POUNDS ANNUALLY

THE AJAX WYATT INDUCTION MELTING FURNACE

ASSOCIATE COMPANIES:
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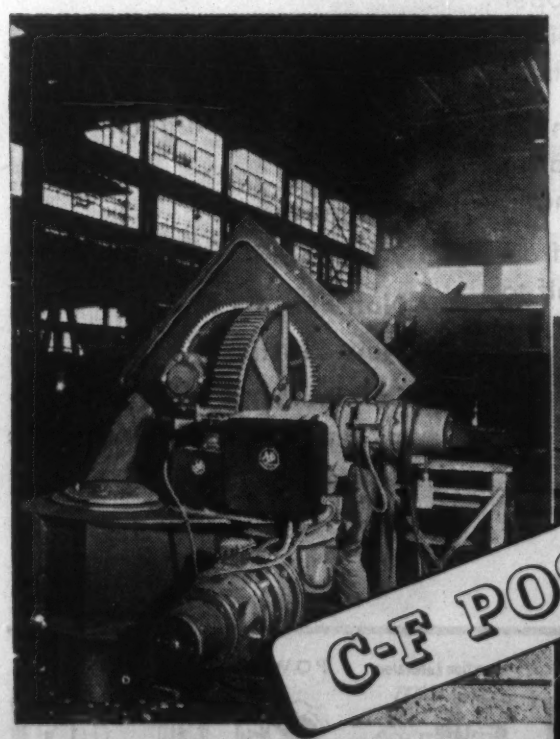
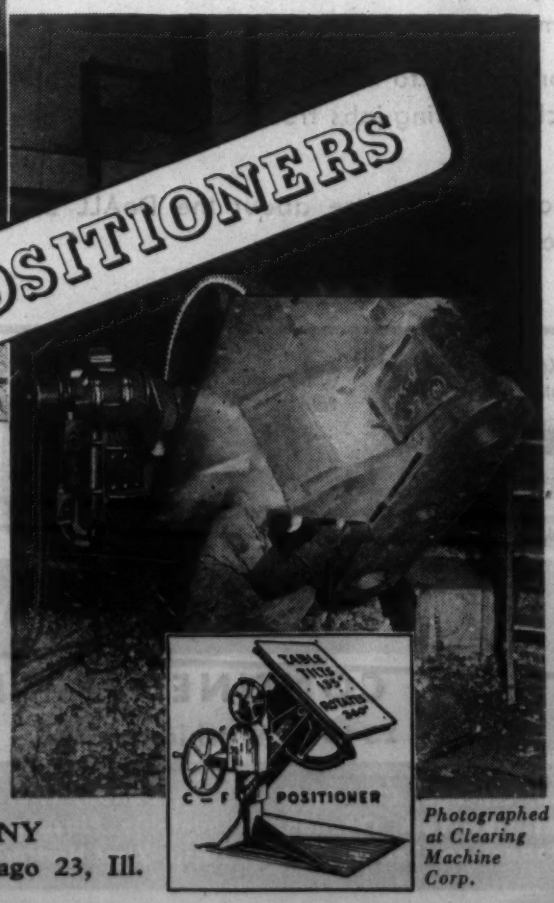
AJAX ELECTROTHERMIC CORPORATION, *Ajax-Northrup High Frequency Induction Furnaces*
AJAX ELECTRIC COMPANY, INC., *The Ajax-Hultgren Electric Salt Bath Furnace*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces*



a Better Job more *Safely Done*

C-F POSITIONERS



Photographed at Clearing Machine Corp.

C-F Positioners permit more welding in the same time, more safely, save crane and sling crew time, save floor space. It's stronger, better welding, too,—uniformly stronger joints, and smoother, neater fillets and beads which eliminate excessive grinding. Permit you to make downhand welds on all sides, surfaces and angles with a single setup, to use large rods that require fewer passes. Table revolves 360°, tilts to 135° beyond horizontal—adjustable for height. C-F Positioners are provided in capacities to 30,000 lbs. hand or push-buttons control operation. Table rotation from 0 R.P.M. up. Pedestal or boom mounted to give maximum floor and working clearance.

Write for Bulletin WP-22

CULLEN-FRIESTEDT COMPANY
1314 So. Kilbourn Ave. Chicago 23, Ill.

Briefs on Associations, Promotions, Education

The immediate cancellation of all non-war connected conventions, trade meetings and conferences, as well as all non-essential civilian travel, was demanded by J. Monroe Johnson, director, Office of Defense Transportation. "The pressure of rail shipments of war material has not yet reached its peak. Organized troop movement combined with increased casualty transportation is gaining in record-breaking proportions," he said.

Alan D. Dauch, vice president, George J. Hagan Co., Pittsburgh, has been elected president of the Industrial Furnace Manufacturers Assn.

William M. Caldwell, formerly senior business specialist in the gray iron and malleable castings section, Office of Price Administration, has been appointed assistant to the executive vice president of the Gray Iron Founders' Society. He will devote major time to the foundry cost program, and will have headquarters at Washington.

The Pressed Metal Institute has chosen as president F. C. Greenhill, vice president, Acklin Stamping Co., Toledo, Ohio, succeeding George E. Whitlock, president, Mullins Mfg. Co., Salem, Ohio. District groups have been organized in nine areas.

Dr. Lillian M. Gilbreth and Dr. Frank B. Gilbreth (posthumously) have been awarded the 1944 Genry Laurence Gantt Memorial gold medal "in recognition of their pioneer work in management, their development of the principles and techniques of motion study, their application of those techniques in industry, agriculture, and the home, and their work in spreading that knowledge through courses of training and classes at universities." The medal is sponsored by the American Society of Mechanical Engineers and the American Management Assn.

At the 13th annual meeting of the Porcelain Enamel Institute at Cleveland, Richard H. Turk, executive vice president, Pemco Corp., Baltimore, was elected president.

Nominated for president of the American Society of Mechanical Engineers is Alex D. Bailey, vice president, Commonwealth Edison Co., Chicago. Election will be by letter ballot, closing Sept. 26, 1944.

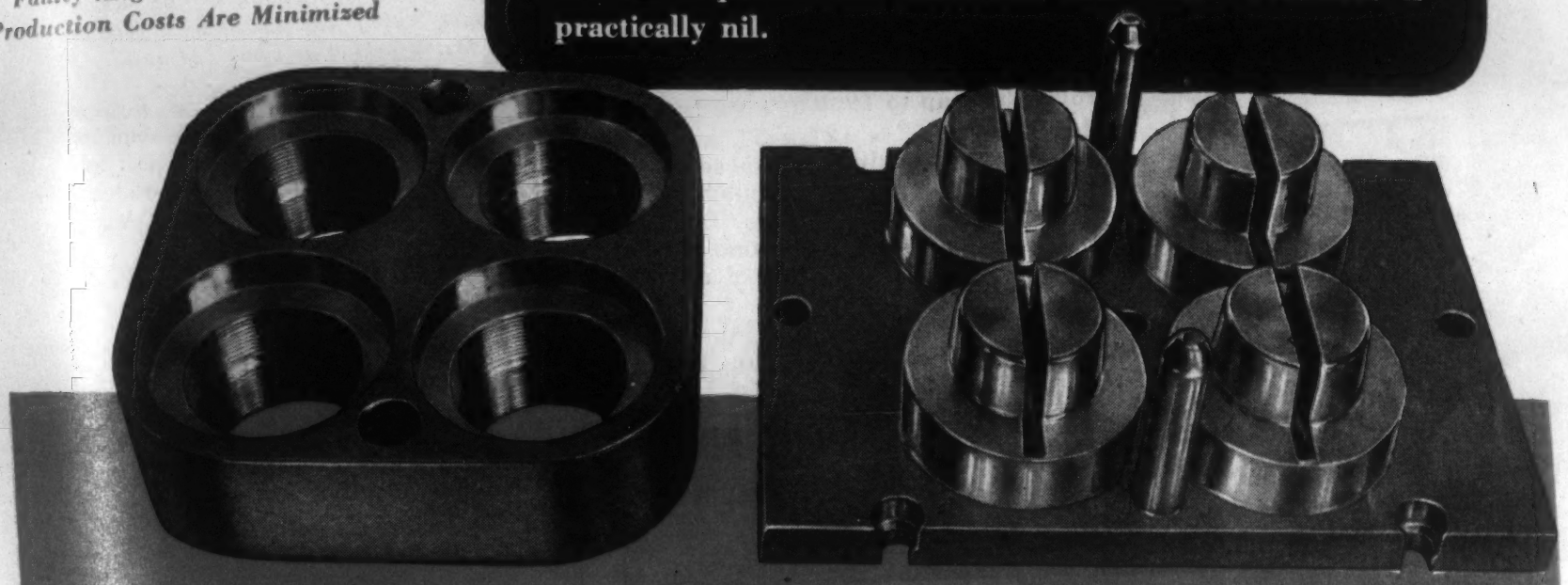
More than 2500 products manufactured or processed by 135 industries are ordinarily packaged in steel containers, according to a survey by Can Manufacturers Institute. States the president, F. J. O'Brien: "The inherent advantages of the steel and tin container are so great that we are confident that the post-war world will see at least the same number of products packed in the familiar tin cans."

"Investigation has shown that the organic reagent, dithizone, can detect copper rapidly in a nickel plating solution and that it is capable of detecting quantities of copper as low as a few micrograms," Dr. B. B. Knapp, chemist, declared in a paper before the

Speed Treat Savings

66% Lower Material Cost
Better Machinability and Finish
Weight Is Reduced
Better Heat Treatment Response (pack hardening produces an .050" case and a uniform hardness of 61-62 Rockwell "C")
Heat Treatment Distortion Is Negligible
Danger of Die Breakage Due to Faulty Alignment Is Eliminated
Production Costs Are Minimized

Pictured is a 7" x 7" x 1⅞" compression mold die of *Speed Treat* plate, used on a 60-ton press for making ordnance parts. Cavities are 3" dia.; wall between cavities .250"; outer walls .375". Note split construction of male die heads which would be impractical in tool steel (because of tendency to crack), yet over 500,000 impressions have so far been made from a similar set of *Speed Treat* dies. Female die must be removed from press after each impression to remove finished parts. Smaller metal section and lighter weight of *Speed Treat* dies is liked by women operators. *Speed Treat* replaced tool steel costing three times more, yet machinability and finish of *Speed Treat* are far superior and distortion after heat treatment is practically nil.



Speed Treat Plate Is The Basic Steel for the Tool and Die Industry

Speed Treat steel plate lends itself to economical production of plastic dies, all types of mechanical rubber molds, many types of blanking, drawing and forming dies, roller dies, brake dies and miscellaneous jigs and fixtures.

A .50 carbon *free machining* hot rolled steel plate, *Speed Treat* affords high physical and good hardenability properties formerly found only in expensive grades of special analysis steel.

High tensile strength, free machinability, ready hardenability and constant uniformity are features of Speed Treat plate. It responds excellently to all types of heat treatment.

If you are still tooling up on war jobs or planning your postwar tool and die production, try out *Speed Treat* carbon steel plate now to learn of its many superior economy values. *Speed Treat* costs only one-third as much as water hardening tool steels.

Send for Catalog No. 1243 and the name of your local *Speed Treat* plate distributor

W. J. HOLLIDAY & CO.
"Established 1856"
Hammond and Indianapolis, Indiana

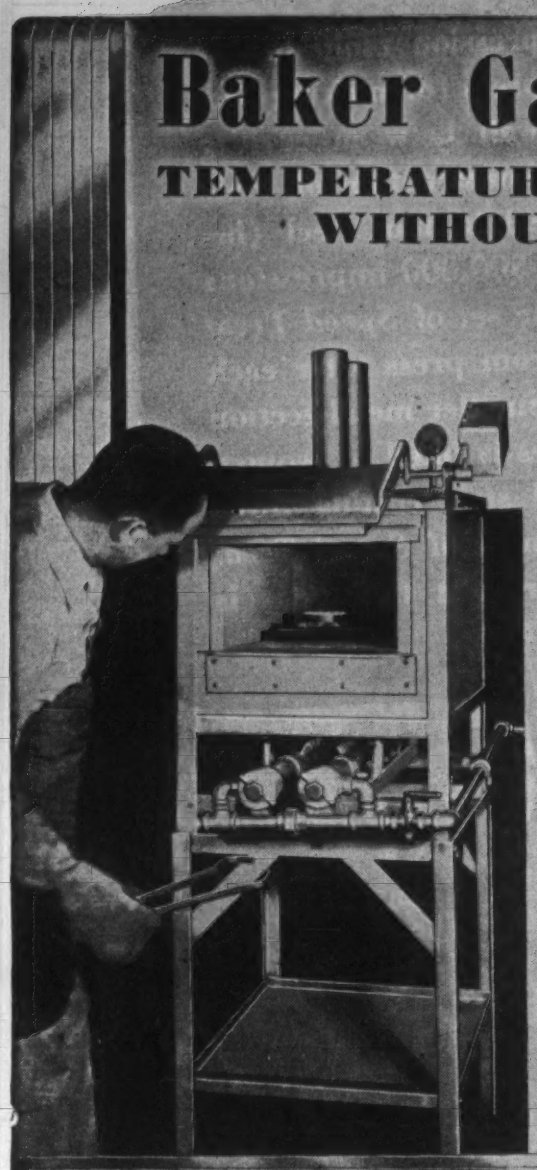
Speed Case—Speed Treat Plate Division,
Hammond, Indiana

Distributors in Principal Cities

Quality Controlled Speed Case and Speed Treat Steel Is Available in All Common Plate Sizes

Baker Gas Furnaces

TEMPERATURES UP TO 2400° F. WITHOUT A BLOWER



BAKER Blowerless Gas Furnaces are very low in gas consumption, noiseless in operation, reach the required temperature rapidly and are equipped with thermocouple and accurate pyrometer. The research departments of some of the largest corporations have contributed to making their high efficiency possible.

There are 9 standard stock models ranging in size from No. 1 (Bench type), which is 6" x 8" x 5½", to No. 24, which is 12" x 20" x 8" as illustrated. All provide uniform, controlled heat up to 1900° F.

Model No. 5, 6" x 12" x 5", is built especially for treating high speed steel. Gives uniform, controlled temperatures up to 2400° F.

We stock one Hydrogen Atmosphere furnace, No. 12, with a closed muffle 8½" x 15" x 2½" high.

Special size furnaces built to your order. Write for descriptive folder and prices.

BAKER & CO., INC.

113 Astor St., Newark, N. J.

In War, as in Peace...

CERRO ALLOYS

SAVE TIME and CUT COSTS!

CERROMATRIX (Melting Temp. 250°F.) For securing punch and die parts, anchoring machine parts without expensive drive fits, short run forming dies and other metal-working applications.

CERROBEND (Melting Temp. 158°F.) Used as a filler in bending thin-walled tubing to small radii. Easily removed in boiling water. Also used for aircraft assembly jigs, templates for forming dies and other purposes.

CERROSAFE (Melting Temp. 190°F.) Used to accurately proof-cast cavities such as molds, gun chambers, forging dies, etc., and for many similar applications.

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CERRO DE PASCO COPPER CORPORATION

40 WALL STREET NEW YORK 5, N. Y.

American Electroplaters' Society at Cleveland

P. H. Bates, chief, Clay and Silicate Products Div., National Bureau of Standards, Washington, has been elected president of the American Society for Testing Materials.

The third National Chemical Exposition of the American Chemical Society, to be held in the Coliseum, Chicago, Nov. 15-19, will be of special interest to chemists, physicists, engineers, purchasing agents and production executives, states advance publicity.

The "Reader's Digest" offers $25,000 in prizes "for ideas for little businesses for returning veterans." The idea is based on the belief that many will want to establish small enterprises of their own. The "Reader's Digest" itself was started by a veteran of the first World War who "had an idea."

"Resistance welding scores its biggest economies and manufacturing improvements when the product itself is designed for welding," states Floyd E. Taylor, president, Resistance Welder Manufacturers' Assn., 505 Arch St., Philadelphia 6.

K. Headlam-Morley has succeeded G. Shaw Scott as secretary of the Institute of Metals, continuing as secretary of the Iron and Steel Institute. Mr. Scott retired on June 30. The address of the Institute of Metals is 4 Grosvenor Gardens, London, S.W.I.

News of Engineers

Dr. Zay Jeffries, noted scientist and pioneer in tungsten metallurgy and development of high strength aluminum alloys, has been elected to the board of trustees of Battelle Memorial Institute, Columbus. Dr. Jeffries is technical director, Lamp Dept., General Electric Co., Cleveland; chairman, Carboloy Co., Inc., and vice chairman, War Metallurgy Committee, National Academy of Sciences and National Research Council.

Arthur S. Shoffstall has retired as general manager, Huntington Works, International Nickel Co., Inc., to become consultant to the head office of the company. He joined International Nickel in 1908. *Herman M. Brown,* assistant general manager, has been made general manager at Huntington, while *John A. Marsh,* general superintendent, has been chosen assistant general manager.

J. Edward Donnellan has resigned from the American Society for Metals, Cleveland, to join General Alloys Co., Boston, as vice president in charge of sales. He is probably best known for his work as editor of the "Metals Handbook."

B. L. McCarthy, chief metallurgist, Wickwire Spencer Steel Co., has been made assis-

LANDING WHEEL CASTINGS *Must be right!*

OUR planes don't find landing fields that are smooth and polished. That's why their landing wheels must be produced to exacting physical and chemical specifications . . . to withstand extreme shock and impact.

Our foundry is equipped to produce such aircraft parts and is producing them for a number of companies to their precise specifications. The experience thus gained places us in an excellent position to handle post war work, whether it be for airplanes, portable or manually handled tools, reciprocating parts of machinery and equipment or other appliances where light weight and great strength are necessary.

Your inquiries on war or post war production are invited.

Photo above shows a Landing Wheel Casting which we are producing for Bendix Aviation Corporation.

FOUNDERS OF NONFERROUS ALLOYS SINCE 1870

HILLS-McCANNA CO.

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Proportioning Pumps • Air and Water Valves • Chemical Valves
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THE RITE PRODUCTS

are always the right products

FOR CLEAN STEEL

AND INCREASED PRODUCTION

LUNKE-RITE — an extremely effective exothermic, powdered compound for the control of piping in steel ingots poured *with or without*, hot tops; and in steel castings. It increases ingot yield considerably. The additional heat created has a beneficial effect on quality of steel by reducing rate of cooling in center section of ingot, which has been found to prevent internal cracks and laminations. This fact is especially important for large forging ingots.—Also used for fitting ladle stopper into nozzle;—as covering of nozzle and stopper head, which, as several plants claim, eliminate any dripping during the pouring;—as cover on steel in ladle where duplexing or reladling is practiced;—as cover on hot metal being transported a distance from blast furnaces.

A grade of LUNKE-RITE for every need.

RITE-MELT CLEANSER — a strongly effective powdered compound, containing no aluminum, placed on bottom of ladle just before tapping heat; or into stream as soon as it begins to flow into ladle; preferably on bottom of mold, thereby gaining greater advantage by preventing stool-stickers.

RITE-SULPHUR REDUCER — put on bottom of ladle just before tapping heat; or into stream as soon as it begins to flow into ladle. Reduction according to original content of Sulphur.

CONRAD WOLFF

Manufacturer—Owner of

THE RITE-PRODUCTS CO.

Irvington 11, N. J.

Additional Products:

RITE-TONERDE — finest levigated alumina.

GREEN-ROUGE POLISH—levigated chromic oxide.

MILD POLISH—levigated tin oxide.

SHARP POLISH—levigated cerium oxide.

P. O. BOX 448 NEWARK 1, N. J.

tant general superintendent of the Buffalo plant. *C. A. Gordon* has been made superintendent of hot departments at Buffalo, having for many years been in open hearth and hot mill departments.

Marcel A. Cordovi, formerly research assistant, Welding Research Council, Engineering Foundation, has joined the Babcock & Wilcox Tube Co., as research metallurgist.

S. F. Udstad has returned to American Car & Foundry Co., Berwick, Pa. as assistant to the general mechanical engineer after two years with WPB as assistant chief of Rolling Stock section. He has done much with calculations of stress and strain.

Thomas J. Kearney, formerly technical advisor to the director of sales, has been made assistant chief engineer, Detrex Corp., Detroit, maker of metal cleaning equipment.

Charles E. Sorensen, who built an international reputation as executive vice president and general manager of Ford Motor Co., has become chief executive officer of Willys-Overland Motors, Inc. and is to be elected president of the company. He is regarded as the originator of the automotive assembly line.

Walter L. Maxson, manager and chief engineer, mining div., Allis-Chalmers Mfg. Co., has been named director of research, Oliver Iron Mining Co. In his earlier years he was metallurgist with several copper companies, and has taught metallurgy at the Colorado School of Mines.

Arthur S. Klopf, foundry manager, Hansell-Elcock Co., Chicago, has joined Firegan Sales Co., Chicago, as manager of the Iron Div. Recently he was elected president, Chicago chapter, American Foundrymen's Assn., and is secretary of the A.F.A. "Analysis of Castings Defects" committee.

A. H. Kruger, associated with the industrial heating and processing industries for 19 years, has joined Wheelco Instruments Co., Chicago, as application engineer.

Donald B. Williams has been appointed assistant chief metallurgist, Duquesne Smelting Corp., Pittsburgh. He was formerly with the Homestead Works, Carnegie-Illinois Steel Corp., and more recently was metallurgist at the Duquesne Works, same company.

C. P. Croco has been made manager of a newly-formed welding department of Westinghouse, at the Trafford, Pa. Works. Recently he was director of engineering, Federal Machine & Welder Co., Warren, Ohio. He is the inventor of the "Tensiometer," patented device for maintaining tension between stands on cold rolling mills.

N. B. Lantz, formerly industrial gas engineer, Public Service Co. of Indiana, has been appointed manager, Standard Equip-

SILVER

BRAZING ALLOYS:

"Readyflow"—56% Silver—works at 1165 deg.

B 201 —20% Silver—works at 1485 deg.

Also many other standard and special compositions.

ANODES:

Of all desired dimensions.

FLUXES:

For use with Silver Brazing Alloys.

Write for booklet "MA"

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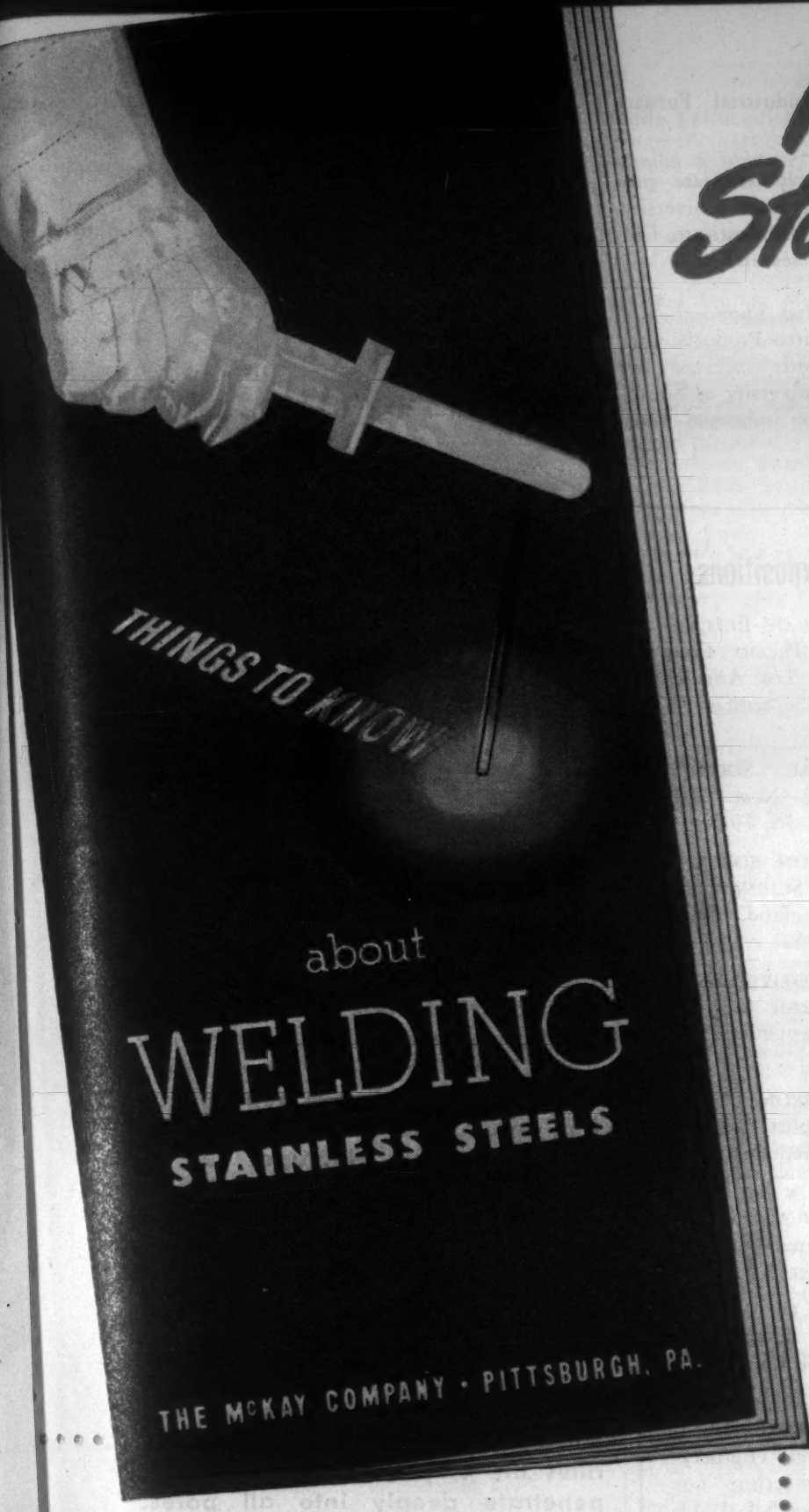

Interested in Stainless Welding?

this Free Book answers many questions about Welding Stainless Steels

The more you know about the characteristics and reactions of stainless steel, in its many analyses, the better able you will be to cope with the problems of welding it.

The McKAY line of Stainless Steel Welding Electrodes is as *complete* as it is *excellent.* You can utilize each grade of McKay Electrode most effectively . . . and avoid pitfalls before you meet them . . . by keeping abreast of stainless developments. Stainless Steel has been called the "metal of the future." Know-how, gained now, will pay big dividends later.

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		True	False
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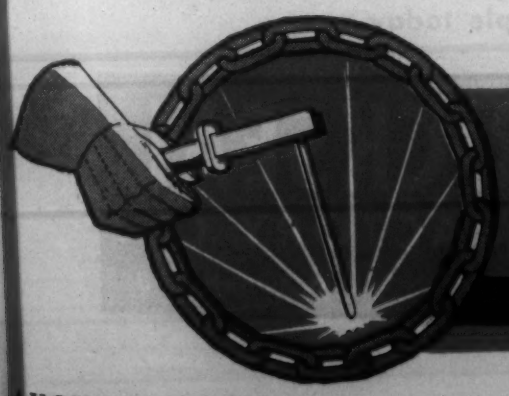
5.	Titanium Metal is an excellent carbide stabilizer but if placed in Electrode Coatings or Core Rods it will not prevent Carbide precipitations in the weld metal.	☐	☐
6.	Grain growth in straight chrome steels is caused by carbide precipitation.	☐	☐

Answers: (4) True (5) True (6) False

Questions 1, 2, 3 appeared in last month's ad. Other questions will appear next month. Watch for them!



General Sales Office: York, Penna.

THE McKAY COMPANY
PITTSBURGH, PA.

WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS

Instrument tells exact moment when FURNACE PURGE is complete

MEASURE specific gravity of generator gas with the Ranarex* instrument and continue purge until the specific gravity is the same at the furnace outlet as it is at the inlet. At that point you can be sure there's no air in the gas. Danger of explosion is reduced and over-purging for safety is unnecessary.

Helps control quality

Ranarex also makes it easy to maintain uniform composition. Just measure the specific gravity of the raw gas and atmosphere gas. The instrument is quick, accurate, easy to use. It contains no chemicals or fragile parts.

Free booklet will be sent on request to The Permutit Company, Department A17, 330 West 42nd Street, New York 18, New York. In Canada: Permutit Company of Canada, Ltd., Montreal. *Trademark Reg. U. S. Pat. Off.

PERMUTIT'S
RANAREX

ment Div., Dempsey Industrial Furnace Corp., Springfield, Mass.

LeRoy Tucker, formerly associate professor of mechanics, Ohio State University, has joined Battelle Memorial Institute, Columbus, to do production research.

Miss Jean Wynkoop has joined the organic research staff of Turco Products, Inc., Los Angeles. She recently received her M.A. degree from the University of Southern California for work on industrial water softeners.

Meetings and Expositions

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Pacific Coast Technical meeting. Los Angeles, Calif. August 29-September 1, 1944.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting. New York, N. Y. September 11-15, 1944.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, annual meeting. Cleveland, Ohio. September 11-16, 1944.

SOCIETY OF AUTOMOTIVE ENGINEERS, national tractor meeting. Milwaukee, Wis. September 13-15, 1944.

INSTITUTE OF THE AERONAUTICAL SCIENCES, air transport meeting. Washington, D. C. September 22, 1944.

ASSOCIATION OF IRON AND STEEL ENGINEERS, annual meeting. Cincinnati, Ohio. October 2-5, 1944.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Electric Furnace Steel Committee. Pittsburgh, Pa. October 5-6, 1944.

SOCIETY OF AUTOMOTIVE ENGINEERS, national aircraft engineering and production meeting. Los Angeles, Calif. October 5-7, 1944.

AMERICAN SOCIETY OF TOOL ENGINEERS, semi-annual meeting. Syracuse, N. Y. October 12-14, 1944.

ELECTROCHEMICAL SOCIETY, fall meeting. Buffalo, N. Y. October 12-14, 1944.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Institute of Metals and Iron and Steel Divisions, fall meeting. Cleveland, Ohio. October 16-18, 1944.

AMERICAN WELDING SOCIETY, annual meeting. Cleveland, Ohio. October 16-19, 1944.

AMERICAN SOCIETY FOR METALS, annual convention. Cleveland, Ohio. October 16-20. 1944.

WIRE ASSOCIATION. annual convention. Pittsburgh, Pa. October 16-20, 1944.

BRICKSEAL

★Highly-glazed monolithic coating prevents cracking and spalling

Brickseal will reduce to a minimum the danger of untimely failure of furnace refractories. This widely-used refractory coating, applied like paint with brush or spray gun, forms a highly-glazed, heat-reflecting, monolithic, protective surface which prevents damage due to cracking, spalling, slagging, air infiltration and sudden temperature variations.

Brickseal should not be confused with ordinary air-set washes which form a plaster-like surface coating. Brickseal consists of high-fusion clays and metals combined in oils. Furnace heat burns the oils and vitrifies the clays and metals, which penetrate deeply into all pores, cracks and joints, binding the bricks into a durable, monolithic wall.

Brickseal cannot crack, blister or peel off due to sudden temperature changes because, at operating temperatures, it becomes semi-plastic, permitting it to expand and contract with the wall. Brickseal also binds old cracked or loosened bricks. Slag may be removed without damage to lining.

You can secure Brickseal protection with very little cost or delay. Write for sample today.

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By Edwin F. Cone

Another Low Alloy Steel

It has been many months since the low-alloy, high strength steels have been in the picture—steels like Corten, Yoloy, etc. The war has seriously interfered with their production. Not long ago a new one, the first in 2 or 3 yr., was announced—"Aldecor"—developed by the Alloy Development Corp. It is practically the same steel as Corten except that molybdenum is substituted for chromium.

Plenty of Manganese Alloys

For the 6 mos. to July 1, this year, the data of the American Iron and Steel Institute show that the production of ferro-manganese and spiegeleisen is practically keeping pace with the steel output. For the first 6 mos. of this year the average monthly output of both alloys has been 56,082 net tons. For the year 1943 the average monthly production was 56,900 tons.

Employees' Share of Steel Industry's Sales Dollar

Out of every dollar received by steel companies during 1943 from the sale of their products, 40¢ were distributed to employees. This increases the employees' share of the industry's sales dollar 10% in a single year, according to the American Iron and Steel Institute.

Less Magnesium

Orders from the WPB have recently been issued reducing the output of magnesium in several Government-owned plants. The contraction in production approximates 7,500,000 lb. per month.

Aluminum Alloy Freight Cars

The recent order by the Missouri Pacific Railroad for 25 hopper cars (70-ton) to be built of aluminum alloy plates and sheets instead of steel emphasizes a new trend. The cars are to be built by the American Car and Fdry. Co., and the order is regarded as somewhat experimental. Certainly the increase of the pay-load by the use of lighter material—low-alloy steels or aluminum alloys—is important in future transportation.

Lower Shipments of Heat-Treating Furnaces

There has been a decline in the monthly shipments of heat-treating furnaces this year. According to the WPB shipments for the first 4 months of 1944 amounted to $17,881,000—a drop of about 65% from the same 4 months in 1943. New orders for the same period also showed a net decline. Unfilled orders at the end of April 1944 are given as $20,659,000 or about 65% below the same period last year.

Later Data: There was an increase in May of about 25% over April with shipments amounting to $4,817,000. Unfilled orders registered a slight increase for May.

Steel Payrolls and Wages

Payrolls and average weekly earnings of wage workers in the steel industry went up to a new peak in May, says the American Iron and Steel Institute. In payrolls a total of $145,427,000 was distributed during the month as contrasted with $138,860,000 in April and with $137,404,000 in May, last year. The previous record was $145,285,000 in March 1944.

Peak Pig Iron Shipments

The U. S. Bureau of Mines recently reports that shipments of pig iron from American blast furnaces in 1943 totaled 60,787,159 net tons as compared with 59,100,601 tons in 1942. The value last year was also higher at $1,273,634,210 as against $1,227,389,689 in 1942. Data for both 1942 and 1943 were new records.

Iron Ore Consumption

Iron ore consumption for the first half of 1944 is at a new high record. It totaled 44,290,320 gross tons. The previous high for the first half of a year was 44,092,720 tons in 1943. In 1942 for the same period it was 41,940,717 tons. The total for 1943 was 89,027,689 tons. Unless there is an increase in the last half the 1944 total will be less than that of 1943.

Fuel Consumption in Steel Industry

In 1943, a record-breaking year, the steel industry consumed enough electricity to supply 17,178,000 families for 12 months; fuel oil sufficient to heat 1,406,000 homes for a year; coal equivalent to a year's consumption in 12,986,000 houses; and natural gas for 14,470,000 residences for a year. These are data assembled by the American Iron and Steel Institute.